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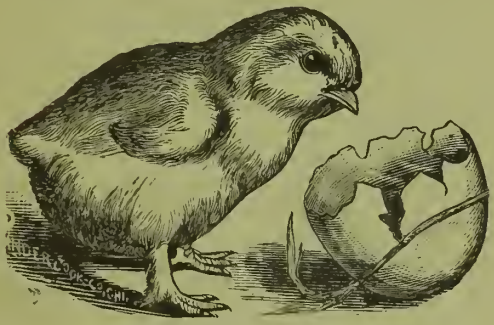
INCUBATION:

Natural and Artificial.



INCUBATORS AND ARTIFICIAL BROODERS.

METHODS OF REARING CHICKENS BY ARTIFICIAL MEANS.

By H. H. STODDARD,

EDITOR OF "THE POULTRY WORLD," "THE AMERICAN POULTRY YARD," AND "THE CO-OPERATIVE POULTRY POST." AUTHOR OF "AN EGG FARM," "POULTRY DISEASES," "POULTRY ARCHITECTURE," "LIGHT BRAHMAS," "WHITE LEGHORNS," "BROWN LEGHORNS," "PLYMOUTH ROCKS," "WYANDOTTES," "HOW TO FEED FOWLS," "HOW TO WIN POULTRY PRIZES," "HOW TO PRESERVE EGGS," "DOMESTIC WATER FOWL," ETC. PUBLISHER OF "HOW TO RAISE POULTRY ON A LARGE SCALE," "A POULTRY COMPENDIUM," ETC.

HARTFORD, CONN.
1886.

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INCUBATION:

Natural and Artificial,

WITH

ILLUSTRATIONS AND DESCRIPTIONS OF INCUBATORS, MODES OF CONSTRUCTING BROODERS, AND THE BEST METHODS OF REARING CHICKENS ARTIFICIALLY.

By H. H. STODDARD,

Editor of "The Poultry World," "The American Poultry Yard," "The Co-operative Poultry Post." Author of "An Egg Farm," "Poultry Diseases," "Plymouth Rocks," White Leghorns," "Brown Leghorns," "How to Feed Fowls," "How to Win Poultry Prizes," "Poultry Architecture," etc.

HARTFORD, CONN.

1884.

PREFACE.

There are some principles, ideas, and facts, pertaining to the subject of this book, that are old. Reproduction requires the same methods or conditions now, as were necessary in all ages past. But the ranks of poultry raisers are receiving new recruits yearly; and these new comers, many of them, call for a book that "tells all about hatching." These old principles and facts are *new* and necessary to the novice. There is a still larger class who are just beginning to learn something of artificial incubation, and are ready to welcome and appropriate any information on this subject. We add another book to our series on special subjects pertaining to poultry, trusting that it will be favorably received by poultry breeders, and meet a demand which seems to us apparent.

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INCUBATION.

THE word *incubate* was formerly used in a more limited sense than it is at the present time. Nine people out of ten will say that incubation is hatching, and ask "If it is not hatching, what is it?" It appears that, strictly speaking, the *sitting* on eggs for the purpose of furnishing heat is incubation; not the mere hatching. But the word has been appropriated as the best to express the whole operation of sitting on eggs, or giving them the required heat to effect the hatching, whether in the natural way, by the hen, goose, turkey, etc., or by the use of contrivances that furnish artificial heat with boxes, drawers, lamps and regulators. A word must in the long run be made to answer the purpose of those who use it, even if the Latin derivation is ignored. Words get their meaning changed or extended, in time. Man invents some new method, and uses an old word to express his idea.

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When the novice desires to learn all that can be learned about incubation he may well commence at the beginning and consider the best methods of obtaining eggs that will hatch when placed under favorable conditions.

All eggs will not hatch. A certain proportion generally, as gathered from the breeding stock, will be found infertile; the germ never having been fecundated, or from some weakness or malformation in the hen there may be a deformity in the eggs, one side not being equal to the other, showing flatness more or less. The shell should be equal in thickness and strength and have no weak spots. Eggs having thin or imperfect shells are very likely to become broken. A broken egg among others is a nuisance. If this takes place under a sitting hen the rest of the eggs become unpleasantly daubed and the fine pores of the shells closely sealed as if by a coat of varnish, preventing the continued formation of the chicks. When such an accident occurs, the eggs affected should be carefully washed in warm water and immediately returned to the hen or incubator. But "an ounce of prevention is *better than* a pound of cure;" hence we say —choose well-formed, symmetrical eggs with strong, perfect shells.

Sometimes the sterility of eggs may be on account of the lack of virility on the part of the male bird. This is the occasion of great disappointment if it is only found out in the midst of the hatching season. A remedy can not be effected in a day, and before a change in the mating can be made the best part of the hatching season may be past and many eggs lost. Breeding fowls should be mated early in the season; then the eggs may be proved or tried before the middle of March, by using a few, placing them for a short time under incubation, thus making sure, by examination, that all is right.

The first laying of eggs dropped by a pullet should

not be used for incubation. They are not apt to be all fertile ; besides they are small, and small eggs will give small chickens. These small eggs do not, where they hatch, make the strongest chicks. A vigorous bird at the start, one that walks on his two legs without help soon after bursting the shell, is the one to grow and escape all the ills that lie in wait during the after development. If the eggs are laid by hens two years old or more there will be more certainty of hatching, and more substance in them. The larger the egg the better, provided it has but one yolk. Double yolk eggs have, in some instances, produced twins, but they are of the worst kind. If they do not die before coming out they will generally die soon after.

The proper fecundation of eggs is so important that care should be taken to provide males healthy and active. A cock one year old may be mated with hens two or three years old to advantage. The eggs of pullets, after they have laid their first litter, may be used. In this case it is best to mate them with a cock two years old. It ought not to be necessary to remark that the cock should not be nearly related to the hens, but it is, for there is always a class of breeders who advocate close breeding of both fowls and other domestic animals. Let all the arrangements be such as to produce vigorous life. Unless the eggs have all these favorable conditions there will be a considerable per cent. of loss by non-hatching, and another loss of weaklings after hatching. Why is it that some broods of chicks seem strong and healthy, all living and growing up to maturity, while others in another yard, under another management, are fewer in numbers at

the beginning; the numbers every day becoming less, dropping off one by one, in spite of every effort to rear them? The fact is here: something is wrong, in most cases, before the commencement of incubation.

Eggs for hatching should not be kept for a long time in one position. They *may* hatch well after being kept several weeks, and if they are so kept it is necessary to turn them frequently. But the newer the eggs the better for any purpose. They are not like wine. Each one is supposed to contain a germ of life, impregnated, and also the material surrounding it, sufficient to form a perfect young bird in all parts; and this is brought about by the application of heat.

It is sometimes desirable to keep eggs for a considerable time in waiting for a broody hen, in cases where only few hens are kept; and if it occurs in early spring, care should be taken not to have them in a low temperature. In the natural way there is a warming up every day when the hen goes on the nest to lay. If we take away the eggs and keep them in a room almost cold enough for freezing during some nights in February and March, there need be no surprise if they do not hatch when kept under a faithful sitter twenty-one days. Eggs for hatching have been kept in a warm cellar with good results. It is well to turn them over daily. To save labor the eggs may be placed in a box, putting cotton or some other soft substance at the bottom and top, filling the box and securing the cover with screws. Then the eggs may be turned by turning the box each day.

THE SITTING HEN.

Though a hundred machines may have been invented for artificial hatching, many of them, when well managed, doing good work, yet the sitting hen should not be passed by merely for the reason that she practices an ancient method of producing chickens. She does the business now in the same way as thousands of years ago, and every inventor of a machine has been under the necessity of consulting her in order to get "points" regarding temperature, moisture, time and turning. She holds no letters patent issued by government, yet she has precedence of all inventors. Hundreds of men with inventive genius have puzzled their brains to find out a method of doing on a large scale what biddy does equally well in her small way. This is commendable. But live hens must be hatchers for ages to come. Only a few of those interested in raising chickens wish to go into the business extensively. There are farm yards by the thousands in every state, where chickens must follow the mother-hen; and the mechanic with his little poultry house and limited space will hatch and raise chickens in the old way. So we conclude that far the larger number of our readers would choose to learn something of that ancient method of incubation, so common even now, and practiced long before the Egyptian made a hatching-oven or the American a machine.

The inventor inserts his thermometer deftly under the feathers of the sitting hen, and among the eggs, on top of them, under them, and finds that the temperature ranges from 98° to 106°, it being less under them than on top, the highest temperature being among the feathers. It is

also ascertained that this inequality is not maintained, that is, the eggs do not remain in one position. They are turned over frequently, and those in exposed positions brought into the middle of the nest. Thus we see that nature must be consulted in order to "improve on nature." And it is truly wonderful, the sitting hen and her eggs, the constancy and patience of the bird under her instinct of reproduction, and the daily changes in the eggs as they are subjected to the proper temperature. A hen becomes broody. Why is she broody? Does she think —in the way hens think—"Now I've laid about as many eggs as I can cover, and enough to give me a nice brood of young ones, I will lay to and sit"? Sit she will when once resolved though she is possessed of only one egg, and she has been known to persist in sitting on the ground, with not a germ of a chicken, not even a clam-shell, under her. The broody hen is under a strong influence. She is bound down by an unerring, irresistible force which we call instinct. Hereditary influence has much to do in this case. If note is taken of birds of different species, in the wild state, it is found that they lay a certain number of eggs, hardly ever varying—just what they can cover well, and then sit. This habit seems fixed, and we are certain to find three eggs in a bird's nest of one kind, five in another of a different kind, and about twelve in another. The progenitors of our domestic fowls were once in a wild state and probably then had a similar habit of laying a certain number and then commencing incubation. This number might have been twelve or sixteen. But this habit has been changed under domestication. Some hens will lay, if let alone, the eggs re-

maining, till there are thirty or more piled in the nest. Why is this? In the first place, man having control in mating has selected from time immemorial, for breeders, the hens laying the greatest number of eggs before sitting. Not all who have raised fowls have done this, but there have always been some who desired improvement and change in many other respects, as in form, color, and laying qualities It may be reasonable to suppose, that in ancient times, when a fowl was noticed to have laid more than what was known to be the natural number of eggs, at one litter, she was considered remarkable. The eggs being used for hatching would perhaps start a prolific strain. This being a variation would only presage other variations in the same direction. Taking advantage of these variations, even if not in a very systematic way, in a long time, would produce what we see now, even the "everlasting layers" and non-sitters.

Another influence to effect this purpose has been the daily removal of the eggs from the nest. The domestic hen comes to examine her treasure, and perhaps add something to it. She finds, each time, only one egg, and that very likely a poor specimen of wood or china. Such a show is not the best to arouse the instinct of incubation, and, therefore, she will wait a few days and lay a few more eggs to gratify her desire for reproduction. Food and shelter are more certain in the domestic state than in the wild state, so that the hen is not obliged to move frequently from place to place. Comparative ease and security with all other influences mentioned, especially man's selection, with hereditary habit, has brought about the prolificness of our domestic fowls.

The hen will sit, after a time, even if she finds only a china egg in her nest, unless she is of a variety that has had the instinct "bred out." She is in a very peculiar condition. Yesterday she laid her egg and cackled; went about with vivacity, and associated with others of her kind. Today we find her still secluded, intent on sitting in one place continually, only clucking as she is approached, or, if aroused, pecking with her beak, as though defending her young, with that bravery which distinguishes animals when an attack is made and their progeny not old enough for self-defence. Even a rat, approaching with evil intent, will sometimes receive blows of a sharp beak that will cause him to retreat.

It is certain that the eggs should not be without a certain degree of moisture. We once made this remark to an intelligent farmer, and he smiled as we spoke of the fact that hens when left to themselves make their nests on the ground, in that way getting the proper moisture necessary for hatching. He was incredulous, and said: "Yes, they do make their nests on the ground; and they make them on the hay-mow if they are allowed to go there; and they make them high in the grain scaffold. Now, let me give an instance. I keep White Leghorns—by the way, they are called non-sitters—well, one of my White Leghorns stole her nest. She had access to one of my barns; and, high-flyer as she was, she chose to lay her eggs on a heap of cornstalks nearly twenty feet above the ground. Not being molested she commenced sitting and performed the job faithfully hatching sixteen chickens, every one in the nest. How is that for high? And where is your theory about moisture now?"

"But, my dear sir," we replied, "what time in the year did this occur?"

"Well," said he, "I think it was in June."

"The atmosphere in June," we remarked, "is quite moist, sometimes for days together. Did the hen fly off her nest daily?"

"Yes, she flew off every morning."

"Ah! in the dewy morning. And how active she was, going about in the grass. She carried moisture in her feathers every day to her high nest, among the cornstalks. There may be exceptions to all rules, but your case is not an exception, excepting as a White Leghorn was found sitting and hatched her eggs. That was an exception."

If eggs be placed under artificial incubation and no provision be made for moisture in the atmosphere surrounding them, the lining inside the shell, at last, becomes tough and not easily torn apart when the chick is ready to pick its way through, and thus a loss may occur even when all other conditions are favorable. So when one goes about the work of preparing the nest for a sitting hen, let him take care to fix the foundation correctly, placing some moist substance at the bottom. An inverted sod will answer the purpose very well, or any substance that will retain moisture for considerable time, furnishing the same in proper degree to the material above. It will gradually evaporate by the heat of the hen's body.

The preparation of the nest is important. It should not be made in a box too small, or just large enough to admit the hen. It should be made of some soft material, as fine hay, there being room enough for a

thick lining, especially around the outside, so that at no time the eggs will be exposed, but well covered by the plumage of the sitter. The sides should not be made too abrupt, but dishing enough so that the eggs will not roll down, for they should be side by side, and be easily moved by the sitter from the outside to the middle, changing them occasionally from the coolest place to the warmest; for this she does. If the nest is too small, and not of proper shape, the eggs will accumulate, one on top of another in the middle, and then are quite liable to get broken. Make the nest slightly concave with a good thickness of material around the outside, and it will be right. If the hen is not accustomed to the place she should be wonted before introducing the eggs. Give her a few false eggs of china or wood, and if she stays on a day, comes off for her first "outing" and goes back, it is safe to give her good eggs. How should this be done? The best time is in the night. Go after dark and slip the eggs under her. This will make no disturbance—not a ripple. A nest full of eggs will cause contentment, and a strong attachment to the place.

How does the hen behave? If she be a good sitter, she only sits and sits—most of the time; but occasionally she moves. If we mark the eggs that are on the outside, we shall find, perhaps the next day, that they have been moved to the middle of the nest, others taking their places. Thus the eggs are turned and change places at the same time. The eggs are moved and turned by the legs and beak. A very heavy sitter is apt to break eggs in this operation, hence medium or small hens generally make the safest sitters.

It seems that instinct, coming by inheritance through the ages past, is a sure guide. The eggs need turning, that the germ which is near the top of each egg as it lies, may change its relative place during the early days of incubation, so we observe the hen crooking her beak and neck about them to move them one at a time.

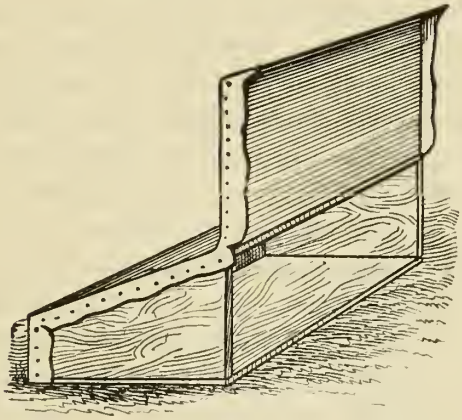
It is also in the fitness of things that the eggs have ventilation, at times. The sitting bird must have food, and the leaving her nest for the purpose of supplying her wants affords an airing to the nest. Then the temperature goes down some degrees, not to the injury of the eggs, however. It is not necessary that the temperature be 1038 every hour, but if this natural ventilation by the hen coming off, be too frequent, or too long continued, it will cause delay in hatching, lower the vitality of the chicks that do hatch, or prevent hatching altogether. It is interesting to notice the movements of a good sitter in these daily vacations. If the weather is cold and windy, as it is apt to be in the month of March, she will go about lively, as if there could be little time for feeding, and soon take her place on the nest again. But the same hen sitting in summer, when the temperature is high, will leave her nest for quite a long time, and go off to a greater distance. She is in no hurry, and could not do better if she had reason, like the builder of a machine. She seems to know that the wick should be turned down a little, and that her eggs, when left, will cool slowly.

Ordinarily, in twenty-one days eggs will hatch, when placed under incubation. This appears a short time for

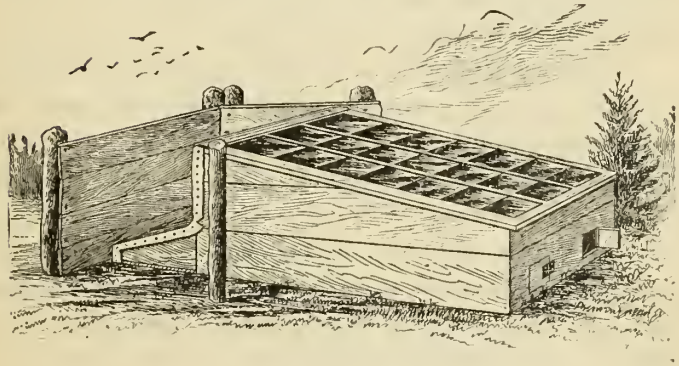
such a wonderful change. On the first day the shell is full of material, with a mere bubble of air at one end, and on the last day all the space is occupied by a living bird with claws and beak, the latter furnished with a sharp appendage which is for the sole purpose apparently of cutting the shell in such manner as to afford a convenient exit. The chick comes out struggling and damp. Nature has given sustenance to last twenty-four or forty-eight hours, for the whole yolk of the egg has been absorbed into the chick's digestive organs, and answers as food. No feeding is necessary during that time. Only a quiet, warm place does the chicken crave, and this is afforded by the hen, if she be not unduly excited by the motherly duties devolving upon her. Just here is an opportunity for the skillful poultry keeper to "assist nature." The chicks may be safely removed soon after hatching, and placed in a warm place or artificial brooder, and thus avoid accident. Some people prefer to rear chickens without the aid of a hen. If this is done, there must be preparation beforehand. There must be provision for warmth, and several methods have been devised. Without at present describing artificial mothers as made and sold by inventors of machines for hatching, we will give an illustration of a brooder of home-made kind, which has proved useful. The drawing and description were sent to us by Rev. Hugh Smythe, of Elizabeth, N. J.

He writes: "I send you herewith drawings of a home-made brooder. The sash is the only part which everybody may not be able to construct at home. It may be of use to some of your readers. I used it last

spring with exceptional success. It consists of a common garden frame which I easily put together myself (the sash cost $2.50 already glazed and painted) and a slanting brooder fitted to the back, or higher end. The brooder



BROODER.



BROODER AND FRAME.

HOME-MADE BROODER.

proper is made with a board floor, and ends, and covered with tin—mine was tin from an old roof. This is made to slant back as represented in the drawing to about four

or five inches at the back. The front is open to the run inside the frame under the glass. The tin is turned over at the ends and tacked fast. It is also continued up above the level of the glass and turned over to shed the water. Stakes are driven into the ground eight or ten inches back from the brooder, and rough boards are fitted to them inside, and the whole is then filled in with fresh stable manure closely packed down. The tin keeps the inside of brooder free from damp and smell. It should be prepared a day, or two days before the chicks are put in. The heat will then be as much as they need, or can bear. Flannel may be used, but none is needed. I found out that my chicks preferred to get close up to the warm tin, and the outside ones would stand on tip toes to get up to it. The holes in front of frame are sometimes sufficient ventilation, but the sash may either be drawn down an inch or two, or raised in front by a piece of wood if more air is needed."

When several broods of chickens come off at nearly the same time an artificial brooder may be used with success, saving time and trouble. In such cases each hen may have another sitting of eggs. This is an advantage when sitting hens are scarce, as is sometimes the case in the early part of the breeding season. The hens will go on with the second litter of eggs without detriment; but care should be taken to remove the first brood about as fast as hatched, or the sitter will get a decided bias to leave.

This subject of artificial brooders of home make being of some importance, we give another short description which first appeared in the *Country Gentleman.*

This contrivance may be constructed at a very slight expense.

It consists of a wooden box—a good soap or candle box will answer the purpose well—in the top of which a round hole is made of just the right size to set therein a common milk pan, partly filled with water. Over the pan put a sheet of tin or iron; or a piece of old zinc can sometimes be found, which has served its mission under the kitchen stove, and can now be utilized for this purpose. On this place several thicknesses of cotton or wool, on which place the chicks. Around this, on the top of the first box, place another shallow one without top or bottom, to confine the little fledglings. Over this throw a blanket, etc. In the lower box and under the pan of water, place a small kerosene lamp, which should be so regulated as only to warm the water to a comfortable temperature for the little innocents above. When the water is once warm, the smallest nursery lamp will suffice. Holes should be made in the top and bottom of the box to supply air.

This arrangement, if properly attended to, will make a very good incubator. A few holes punched in the metal plate over the pan would supply moisture—a great desideratum.

One of the best descriptions of a "mother" which we have seen, is given by Mr. L. Wright. The apparatus is that used by Mrs. Cheshire, an English lady.

We quote: "The greatest practical difficulty in keeping any non-sitting breed of poultry, like Leghorns, is that of obtaining a sufficient number of hens from other sources to hatch and rear the broods, which in a large stock is

sometimes a serious obstacle. From the introduction of two such valuable races of non-sitting poultry as Houdans and Leghorns during late years, the need of a really practical incubator is more felt than ever; but even in the absence of this, much can be done to remedy the inconvenience by bringing-up the chickens artificially, or without the hen, leaving her to hatch a second brood, and then dismissing her. We were exceedingly interested to see, in May, 1873, the working of the artificial system as thoroughly and entirely carried out by Mrs. Frank Cheshire, of Acton, Middlesex, so well-known for her fine stock of Light Brahmas. We saw there upwards of seventy chickens, all brought up under an 'artificial mother,' as one brood. They ranged in age from three months to three days, but there was no fighting, or tyranny of the strong over the weak; not one had died (more than we could say of our own), and there was not one sickly or discontented chick in the whole lot; while we were most of all interested to observe that the birds were larger for their age than our own; and that the trouble was nil compared to that of a dozen hens with their broods, to which we went back with a most discontented mind.

"The 'mother' was about 4 feet 6 inches long by 16 inches wide; the top, or heating portion, consisting of a flat tank about 1 inch deep, with the top soldered on, and having only one inlet for pouring in water, or immersing the bulb of a thermometer to ascertain the temperature. This tank extends all over the mother, and is kept in position by a wooden frame, which supports it at about 6 inches high at the front, and some

3½ inches behind. Under the lower or back edge, occupying some 2 inches of the under side, a flue extends the whole length of the tank, which is provided with two chimneys, one at the end or corner near the lamp, the other at the further extremity of the flue. This is necessary for such a long, horizontal flue; for without the first chimney the carbonic acid would flow back and put out the lamp when first lighted, though it will freely travel to the further chimney when the flue is warm; moreover, if the night be warm the first chimney alone may be left in operation, but if cold, the heated air is compelled to pass along the whole length of the flue. The tank has a partition soldered in it, round which the water circulates, and by this means the temperature hardly varies in any part. The lamp is merely introduced under the end of the flue. Any good lamp will do, but Mrs. Cheshire's was the most simple and yet most perfect in its action which could possibly be. A piece of small, brass pipe was put through a loosely-fitted cork (loosely-fitted to give air) in a common glass bottle partly filled with benzine. This bottle is laid on its side on the ground, and a wick being passed through the pipe, the nearly horizontal position of this simple wick-holder enables capillary attraction to draw sufficient fluid through such a length of pipe (18 inches if required) that the most explosive liquids can be used without the slightest danger; moreover, such a wick trims itself as if drawn too far out the surplus is at once burnt off, and a small and nearly smokeless flame produced without any trouble whatever. This lamp is better trimmed twice in twenty-four hours, but will burn tolerably for even the whole of that time without attention.

"Under the tank fits a frame which slides in and out, on the top of which canvas is stretched, to which are sewed the ends of strips of flannel or felt carpet—about 2½ inches long by half an inch wide—which give warmth to the chickens. Mrs. Cheshire informs us that she finds this better than sheepskin, never entangling and strangling the chicks. Under the whole slides a wooden floor, covered pretty thickly with dry mold, which is renewed every day. In the morning the mother would have a little unwholesome smell from the bodies of so many chickens; but our ingenious informant had found an effectual way to remove this, which was easily done by turning the canvas part of the mother upside down, throwing a few shovelfuls of dry earth among the flannel strips, shaking the earth well in, and after letting it remain a few minutes shaking all out again, the little earth that remained adherent coming off on the chickens, and thus benefiting them in another way. This, and the lamp in cold weather, was all the care required, beyond that of the newly-hatched chicks, which was rather a pleasure than otherwise. A rail fence in front of the mother prevented the chickens using it after reaching a certain size, but they were still allowed access to one unwarmed.

"The few difficulties found in starting had been easily overcome. The two essentials were:—first, that the chicks were immediately taken from the hen, so as never to miss and fret after her; and, secondly, that for about two days they needed keeping in a box floored with dry earth, with a small mother at one end, so that they could not wander away from it. This was 'the pre-

paratory school for young gentlemen,' its sole object being to teach them to know the apparatus and how to go under it. As soon as they were perfect in this lesson they were turned down with the others, the whole being treated as one large brood, and agreeing perfectly. Mrs. Cheshire's small mother consisted of an ordinary India rubber foot-bottle filled with boiling water, and placed over canvas about 10 inches square, stretched on a frame, and furnished with flannel strips as in the case of the larger one. This occupied half of a common wooden box, the chickens having the other half to run out in. If a few thicknesses of flannel are placed over the bottle, it will keep it warm enough for a whole night; and even when boiling will not be too hot for the chicks, the India rubber and mother under being bad conductors of heat. Should such a separate infant nursery be thought troublesome, Mrs. Cheshire suggests that a small portion of the large mother may be penned off and furnished with a small enclosed run in front, so that the chicks can not wander away till they have learned to know it, which is the sole object desired.

"Both plans of rearing have been fairly tried by the lady from whom we have obtained these interesting particulars, the comparative results are stated by her as follows: 'The advantages of the artificial plan seem to be—1. Great economy of hens if they are needed for laying. If a hen be cooped with chicks for three [and we shall say five weeks is nearer the mark], she has been six weeks out of the breeding-pen; and after she is returned to it her first four or five eggs will not be fertile. 2. Economy in food; as all eggs, grits and

other dainty food go to the chicks. Special dainties for very young ones are easily given in a feeding-coop, through which the larger ones can not pass. 3. Economy in labor of feeding and cleaning. This is very great, while there is always capital, dry accommodation for the chicks on wet days. 4. The extreme tameness of the chicks. A hen often prevents her brood feeding till the attendant has gone; but under this system little chirpers of three or four days old will run and flutter up to whoever has the charge of them; and they never seem to fight or quarrel. 5. The impossibility of losing chickens by tramping. 6. The greatly increased cleanliness of the chickens, which retain the utmost purity of their beautiful down until its loss. Our experience also proves that they feather more quickly. And, lastly, increased size; we find that we get the same weight on this plan at ten weeks old which we formerly got at twelve weeks. I might add the possibility of raising fine chicks early in the year; since if cold weather comes on they can nestle even at eight or ten weeks old if they will.

"We ought to add that we are thoroughly convinced by actual inspection of the great superiority in every way of this plan of rearing. The principal reason of the success is, in our opinion, that every chick can have as much brooding as it likes, whereas, when with the hen, weakly ones may often be seen and heard entreating warmth and shelter which the vigorous ones do not need, and which the hen will not give. These chicks die off, while with the artificial mother they are nourished into strong birds."

ARTIFICIAL INCUBATION.

The methods of producing chickens by artificial heat are interesting and important to a less number of persons than those who depend on that ancient fashion that is common among the hens that cluck. We never proposed to devote our pages entirely to description of the forty or more machines that have been advertised and put upon the market. Yet this subject of artificial hatching is increasing in importance, and every year a large number of incubators are sold; some of them used with marked success, others only causing disappointment, chagrin and loss of eggs—sometimes loss of temper.

Who can run a hatching machine? Certainly not every one who makes the attempt. The most decided failures have been made in using the best incubators that were ever invented. How shall a man, or a boy, know whether he has the genius to do this thing? If a person is orderly, careful, and understands causation well, he may take charge of an incubator, and be able to show the effects of his skill. If he has not these characteristics he will hardly succeed in taking care of a few sitting hens. Some people have "poor luck" whatever method they use for hatching. A little special education seems necessary; a knowledge of the philosophy and the history of artificial incubation—then a certain tact, or as some express it, a *knack* of doing the business

INCUBATORS,

in the modern acceptation of the term, are now constructed so as to be movable, holding generally only a

few hundred eggs or less, and heated by lamps, the heat being applied to water in tanks or pipes. These are new inventions; but the hatching of chickens by artificial means is not new, it having been practiced at least 2,000 years ago. The Arabs used fermenting horse manure to get the necessary heat. This has been done in England and in this country also, but the method is not likely to become popular for a very apparent reason, however well arranged the apparatus. Commodore Perry has described the method practiced by the Japanese. The eggs are first placed in barrels lined with very thick, spongy paper, to protect them from sudden changes of temperature. They are kept in these barrels during the first stages, the room being heated to the proper temperature by charcoal furnaces. In the latter stages shelves are provided to hold the eggs, several thousand eggs in each room; the same kind of thick paper being placed on the shelves and above the eggs. Probably we have only the main facts, the minor details such as supply of moisture being left out.

The Egyptians have been most noted in the practice of this art; their hatching ovens being represented on a large scale; but modern travelers are somewhat deficient in describing the details of management. This is to be accounted for by the fact that these are kept secret; the men who attend to the hatching-ovens belonging to a kind of close guild. In an account given by a traveler fifty years ago we read that these secrets were only known to a few of the inhabitants of the village of Berme, and a few adjoining places in the Delta, who leave it as an heir-loom to their children, forbidding them to impart it to

strangers. When the beginning of autumn, the season most favorable for hatching, approaches, the people of this village disperse themselves over the country, eacn taking the management of a number of eggs intrusted to his care by those acquainted with the art.

According to the best descriptions of the Egyptian *mamal*, or hatching-oven, it is a brick structure about nine feet high. "The middle is formed into a gallery about three feet wide and eight feet high, extending from one end of the building to the other. This gallery forms the entrance to the oven, and commands its whole extent, facilitating the various operations indispensable for keeping the eggs at the proper degree of warmth. On each side of this gallery there is a double row of rooms, every room on the ground-floor having one over it of precisely the same dimensions, namely, three feet in height, four or five in breadth, and twelve or fifteen in length. These have a round hole for an entrance of about a foot and a half in diameter, wide enough for a man to creep through; and into each are put four or five thousand eggs. The number of rooms in one mamal varies from three to twelve; and the building is adapted, of course, for hatching from forty to eighty thousand eggs, which are not laid on the bare brick floor of the oven, but upon a mat, or bed of flax, or other non-conducting material

"In each of the upper rooms is a fire-place for warming the lower room, the heat being communicated through a large hole in the center. The fire-place is a sort of gutter, two inches deep and six wide, on the edge of the floor, sometimes all around, but for the most part only on

two of its sides. As wood or charcoal would make too quick a fire, they burn the dung of cows or camels, mixed with straw, formed into cakes and dried. The doors which open into the gallery serve for chimneys to let out the smoke, which finally escapes through openings in the arch of the gallery itself. The fire in the gutters is only kept up, according to some, for an hour in the morning and an hour at night, which they call the dinner and supper of the chickens; while others say it is lighted four times a day. The difference probably depends on the temperature of the weather. When the smoke of the fires has subsided, the openings into the gallery from the several rooms are carefully stuffed with bundles of coarse tow, by which the heat is more effectually confined than it could be by a wooden door.

"When the fires have been continued for an indefinite number of days—eight, ten or twelve, according to the weather—they are discontinued, the heat acquired by the ovens being then sufficient to finish the hatching, which requires in all twenty-one days, the same time as when eggs are naturally hatched by a hen. About the middle of this period a number of the eggs in the lower are moved into the upper rooms, in order to give the embryos greater facility in making their exit from the shell, than they would have if a number of eggs were piled up above them.

"The number of ovens dispersed in the several districts of Egypt has been estimated at 386; and this number can never be either increased or diminished without the circumstance being known, as it is indispensable for each mamal to be managed by a Bermean, none of whom are

permitted to practice their art without a certified license from the Aga of Berme, who receives ten crowns for each license."

It is probable that these ovens were closely watched. There was a great value at stake. In the modern machine the design is to obtain automatic action in the regulation of temperature, placing so small a number of eggs under heat that it would only pay the attendant to devote a short time each day to the management.

Inventors make incubators to sell. In our times not many poultry men desire to hatch chickens by the thousands; but there comes a demand for something on a smaller scale. So inventive genius has been directed to the making of machines of 100 to 1,000 eggs capacity because such are wanted and will sell.

In the study of this subject not much has been gained by the experience of the Egyptians as recorded in history, or by what has been done fifty or a hundred years ago in Europe. Inventors have resorted to the sitting hen as a model, saying substantially this: "If we can produce the same effects that she produces, doing the business on a much larger scale; if we can enclose five hundred eggs, more or less, and keep them at the same degree of heat as prevails under her feathers, with slight moisture; if we can apply heat in the same way, not heating the eggs *up* but down; and if we can properly ventilate the eggs, and turn them over at intervals—then we can succeed; of course it is a simple affair."

It was soon found difficult to obtain success in hatching a large per-cent by merely giving the eggs a supply of warm air constantly, without an intervening medium,

or the radiation of heat from above. Air when heated will circulate, but the circulation will be in currents; and this is unlike the gentle even heat that prevails under the sitting hen. Also it was found impracticable to succeed by heating directly from below. The germ of the egg rests on the upper part, as the egg lies; the development requires heat from above, just as seeds in the ground require solar heat from above, the fine rootlets striking downward in the cooler ground—so from the eggs, at the beginning there seems to start out the fine blood vessels, at first downward mainly, or in the opposite direction from the source of heat. Is not this the rule of germination in all nature? The blessing of heat comes from above.

So the early attempts at artificial incubation resulted in failure, many of them, because the eggs were merely surrounded with heated air, or equally heated in all parts. The inventors did not sufficiently recognize the fact that the germ lies at the top in the commencement, and that, in natural incubation, the heat comes from above the eggs, the temperature being five or six degrees less on the under side than on the upper, as shown by the thermometer when thrust under them and above them.

Then how have our latter day inventors accomplished heating the eggs evenly from above? By conveying heat to them through another medium besides air. It has been found that water holds the heat, and imparts it properly, preventing very sudden changes in temperature in case of accident. The water in a tank may circulate and impart heat without causing air currents over the eggs; distributing the heat evenly and constantly. The

use of warm water in this manner, or by circulation in pipes was regarded as an important step in advance.

Using this medium to convey heat to the egg drawers, and heating the water by means of a lamp, there was yet a liability of the temperature lowering sufficiently to cause failure even if the lamp burned steadily. A change of outside temperature, which happens in our climate suddenly at times, might cool the water and cause serious loss, unless, as with the Egyptian ovens, an attendant should be kept watching constantly. The machine must be self-regulating; so much so as not to require attention more then twice in twenty-four hours. No doubt any incubator will do better work when placed in a room where an even temperature is maintained; but, in most cases, this is not practicable, hence the best machines now made are fitted with some device to increase or lessen the flame of the lamp, open or shut a valve, as circumstances require, this being done when the owner is away attending to other business or fast asleep in his bed. These devices are best explained by those who have made them; their working by those who have used them. We give them in their proper place, remarking here that this part of the modern incubator it is that renders it a *machine.*

In writing about natural incubation, we have mentioned the necessity of moisture. It is evident that eggs placed in a hatching drawer must have moisture supplied. Air gets dry by heat. Very dry air surrounding eggs will cause evaporation through the pores of the shells. The linings of the shells become tough, and the eggs lose weight. This shrinkage will cause, in most cases, the death of the embryo, or, if the chick lives to the twenty-

first day it will hardly be strong enough to pick through the tough lining and break the shell. Eggs in an incubator will dry more rapidly than under a sitting hen. Yet they do not require to be kept wet. Too much moisture settling like dew upon them is ruinous. The object is not to get moisture into the eggs, but to prevent their drying up—in other words to keep them "just so." A sprinkling of warm water answers the purpose, and is the method, till lately, in most common use, as it causes humidity of the air in the drawers for hours. Trays of water placed in such locations as to evaporate slowly also give artificial moisture sufficient.

Taking the hen for a pattern we find the eggs have an airing every day. This is good evidence that there should be some provision in every machine for ventilation. Every day during the time of incubation there is chance that an embryo, or a chick well advanced in its development, will perish; and in a steady heat of about 103° there will be a bad odor. People talk about having an incubator in the house. This may be very well if good care is taken in all things; but a sitting hen or an incubator may become very offensive. An exhalation of carbonic acid gas, heavier than air, if permitted to remain in the egg-chamber day after day, and at the hatching time, can but work mischief.

An incubator should have some proper method of ventilation, as good, if possible, as that which the hen provides when she flies off her nest. Bad eggs may be removed from an incubator; a hen may break bad eggs, if left to herself, and ruin all the rest.

When a man buys an incubator he has a strong

desire to succeed. One of the most important factors in the work is a lot of *good eggs.* Will stale eggs do—we mean those several weeks old? Well, such eggs, a certain proportion, will hatch. But in experiments coming under our notice, fresh eggs prove so much better that a man having a new incubator, and wishing to prove its value for hatching healthy chickens, should choose fresh eggs without fail. As this question of stale eggs for hatching is not without interest we insert the following from the *Live Stock Journal* which is an array of facts gained by experiment:

THE INCUBATION OF STALE EGGS.

The question of natural and artificial incubation has been commented upon so often that it is not without a certain hesitation that we approach a subject which is so interesting to all poultry-keepers, and which is merely a *resume* of scientific researches of a high character, and interesting from its very source to the practical result that follows. Mr. Voitellier, in *L'Aviculteur*, has shown what little reliance is to be placed in the old prejudices of people in general and country people in particular on the subject of the success of hatching in what concerns the transit of eggs, the fecundity of which, according to many people, is jeopardized by the mere act of shaking during the journey, as also in summer during a thunder-storm. These two circumstances are essentially very different. We have seen, and we see every day, eggs brought from or sent to long distances, tossed and bumped about either in a carriage or a train, succeed notwithstanding all, although in a scientific point of view the

thing may appear impossible. A case in point happened only the other day: a gentleman hatched out nine partridges out of twelve eggs which he had found in a field, after having had them ten days in his trap traveling through the roughest of crossroads, he being engaged as inspector of horses for the army. The influence of thunder appears, at first sight, to have a bearing on eggs during incubation; but, if it has any effect, it is neither from the noise nor trepidation of thunder; it is simply because the heat is greater and the pressure lower, so that if the hen does not leave her nest there is an elevation of temperature, which surpasses the natural heat and may kill the germ, embryo, or chick. But these are simple accidents, easily foreseen and remedied in natural as well as artificial incubation.

It has been admitted for some time past that stale eggs are useless for incubation; experience has taught us that fact; but up to this no datum, we might even say no serious scientific proof, has been given on this subject. Researches have been made and communicated to the Academy of Sciences on the question of "Teratology," or "study of monsters," which appear to have thrown a new light on this question, and give at the same time most useful indications. These researches are due to a learned investigator of rare talent who delights in the study of "anomalies" or "monstrosities," a dry study, certainly, but full of promise and things unforeseen. This patient investigator has discovered and proved experimentally that tardy incubation had an enormous influence on the hatching, not only in consequence of the arrest of the fecundity of the germs at the time of the formation

of the embryo, but especially by the apparition of monsters or incomplete individualities, in the egg of the hen. "When the egg," says he, "is submitted to incubation some long time after it is laid, the evolution of the germ does not produce a 'normal embryo' but an 'anomalous embryo.'" He adds, which is a valuable indication, that he has proved that the modification of the germ which determines an abnormal evolution is produced more rapidly when the temperature is high than when it is low. Thus in an experiment made in July the eggs had already undergone the modification of monstrosity nine days after being laid.

Other experiments made in autumn, begun in October and extending till January, have confirmed these results, which show that with "a temperature relatively low," eggs preserve for a long period the faculty of being developed in a normal condition, thereby arriving at a state to be hatched. In the first series of experiments, the eggs received from a farm on the first day of October were divided into lots, and submitted to incubation at intervals of several days.

The first lot submitted to incubation, the day after the arrival by rail, had felt (so says the author) the trepidation, the effects of which would be but slight; one egg, or, more properly, one embryo, was normal, four embryos retarded in their evolution, one embryo a monstrosity; these were attributed to the trepidations of the journey. Second series, incubation of 7th October—The eggs were four days old, they produced five normal embryo. Third series, 14th October—the eggs were ten days old; they produced four normal embryo. Fourth

series, 19th October—the eggs were fifteen days old; they produced four normal embryo and two naomalies. Fifth series, 24th October—the eggs were twenty days old, produced three normal embryo, three monsters or naomalies. In the above experiment the abnormal evolution was produced only in the fourth and fifth series, that is to say when the eggs were fifteen and twenty days old. There were also normal embryo in the eggs submitted to incubation twenty days after being laid. The normal embryo obtained in this experiment reached in almost every case the twentieth day of incubation. One-third hatched naturally, the other two-thirds died a little before the hatching, in consequence of the yolk being unable to penetrate the abdominal cavity.

Second Experiment.—Eggs laid on the 19th, 20th, 21st, 22nd and 23rd December were delivered in the laboratory on the 24th December, and were submitted to incubation on the 8th, 10th, 12th, 14th, 16th and 18th January. 1. Eggs 16 days old produced 1 embryo normal, 1 monstrosity. 2. Eggs 18 days old produced 1 embryo normal. 3. Eggs 20 days old produced 1 embryo normal. 4. Eggs 21 days old produced 1 monstrosity. 5. Eggs 22 days old produced 1 embryo normal, 1 embryo abnormal. 6. Eggs 23 days old produced 2 embryo abnormal. 7. Eggs 25 days old produced 1 monstrosity. 8. Eggs 26 days old produced 1 abnormal. 9. Eggs 27 days old produced 1 monstrosity, the eye and left cerebral hemisphere replaced by a vascular tumor. 10. Eggs 29 days old produced 1 abnormal embryo. In this experiment most of the eggs presented no development; the cicatricules or germs were disorganized by the absence of fecundation.

Perhaps in some of these eggs the cicatricules had been impregnated, but had died in consequence of the length of time since they were laid. It is difficult to say whether it is possible to distinguish by physical demonstration non-impregnated cicatricules from fecundated cicatricules although dead at the time of investigation. This experiment perfectly agrees with the preceding one, as one still meets with the normal evolution in eggs of twenty-two days old. Thus the production of monstrosities by tardy incubation takes more time in winter than in summer. In other words, eggs are slower in getting stale when the temperature is not very high. A further consequence resulting from these experiments is that eggs of the same age get stale more or less quickly; that some are developed in a normal manner; whilst others produce monstrosities. This results from the fact of the individuality of the eggs, a fact which has been pointed out long since. These researches, though they belong specially to science, are full of interest, and may one day or other give practical results. The deformations, anomalies—in a word, monstrosities—are under the influence of laws almost unknown, but the discovery of which will enlighten many questions still mysterious, that of fecundation in particular, which comprehends so many problems.

CAUSES OF FAILURE.

It is not unreasonable to suppose that failure to obtain good results, on the part of those who attempt artificial incubation, is laid to the machine, and the maker blamed, perhaps abused by tongue or letter, when more than half the fault was in the eggs. Why is it that in some seasons or localities there are many cases of failure when hens

are used for hatching? We hear one poultry man or another saying, "I have had *poor luck* this spring," yet the same methods and management prevailed as in other years. Good hen-mothers well managed do not always afford "good luck"—so a good incubator may fail to give satisfaction at first trial. There are three factors, the incubator, the eggs and the attendant—three conditions, temperature, moisture and ventilation. Give us fresh, fecundated eggs.

As examples, given in two reports, about artificial incubators, one from a disappointed man, the other from a successful operator, we quote from the *Agricultural Gazette*, of London. The disappointed man makes his report short and sour, "The artificial incubators are *infernal machines*. No practical man uses them." These two sentences were designed to cover the whole ground without any disagreeable details; but the other enlarges, and spreads out like the eagle, thus:—"The result now before us is 72 per cent. of fertile eggs hatched, and, now that the first few days of the young lives are over, we have only lost one of the number. A hen set at the same time brought out only 50 per cent. and a second hen is daily eating one of her eggs, and thus diminishing future pleasures of her maternity. We may add that while we have lost one of our orphan birds, the hen first mentioned has lost one of her little ones, so that the incubator scores at present very high in comparison to the natural means. Hens are certainly "kittle cattle" to deal with, for while one eats her eggs, another clumsily breaks them, and a third leaves them to become cold. The incubator, we find, neither eats, tramples, nor forsakes,

and, if regularly attended to, brings out her chickens up to time.

The whole question seems to us to be a very simple one. An egg requires heat to develop the embryo. This heat can be kept up in a good incubator such as we use with such precision that it does not vary above 2° or 3° in twenty-four hours. It is maintained between 100° and 104° Fahr., and if it falls to 98° or rises to 104°, the defect is easily remedied by regulating the source of heat, and thus bringing back the temperature. It can hardly be imagined that a hen sitting upon eggs, some of which are barely covered, while others are in the center of her nest, should be able to keep the temperature as uniform as this. The somewhat fitful manner in which a hen sits is often a cause of anxiety to her owner, when he has entrusted her with $4.00 or $5.00 worth of pure-bred Dorkings or Houdans. This anxiety is never felt when working an incubator. You look at your thermometer, and when you reach a good temperature you feel satisfied that all must be going on well. No doubt there are some other points to be attended to besides the warmth, such as moisture in the air, ventilation, and regular turning of the eggs. But as every good incubator carries instructions for use, the main point is perhaps that of keeping up a regular warmth. After the eggs have been a week in the incubating drawer they may be examined before a strong light, and all infertile or clear eggs should be removed.

Your incubator is not startled or frightened or cross at these liberties like a hen, and the short exposure during the examination of eggs is on the whole beneficial

to the embryos. After ten days, the natural heat generated by the development of life in the shell, renders it necessary to diminish the external source of heat, and by the end of the period half the amount of water is necessary to keep up the requisite temperature. Having carefully gone through the processes, and having the satisfaction of seeing between fifty and sixty healthy chickens upon the first day of March, with the prospect of as many more before the end of the month, we can not call our incubator an infernal machine.

Young chicks are very helpful little creatures. They soon learn to pick, and do not seem to miss the natural mother. We have, however, met this difficulty in a manner which is very easily adopted by any one. A hen can take care of twenty chickens easily and when hens are abundant, as on farms, twenty newly incubated chickens can be given cautiously to a broody hen, and she will take charge of them. We believe ourselves that an "artificial mother" carefully kept up to the mark will do almost as well.

We have been prompted to make these details of a personal experience chiefly by the expression "infernal machines" used by a correspondent already alluded to. It is perhaps only fair to state that the incubator used in the above recorded experiment was Christy's.

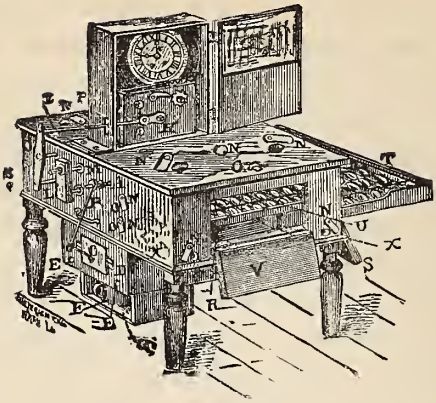
"WHICH MACHINE SHALL I BUY?"

This is the question asked by many individuals nowadays. It is a question that a person who is disinterested will not answer without hesitation.

We would not venture to point out one of the many

that have been put on the market as the best in all respects, for the reason that several incubators have about an equally good reputation. Neither can we, in the place allotted, give a minute description of all the incubators invented in this country. Such reading would be tiresome and unprofitable. But for the purpose of giving the inquirer ideas of the methods of management, heating and regulating different machines, we give a few descriptions—quoting when convenient from the inventors and proprietors themselves, they being best qualified to explain their own work. This is done with no intent to make invidious distinctions. Machines not described or illustrated in this book may be equal in working qualities to those noticed. "Let every tub stand on its own bottom."

It has been noted that two methods are used in heating the eggs: one directly by hot air, the other through the medium of warm water. Let us first notice the Eureka. (See page 40.)



EUREKA.

A. Regulating Screw.
B. Outside Connecting Lever.
C. Valve.
D. Lamp Box.
E. Air Holes to prevent lamp going out when valve is closed.
F. Lamp.
H. Crank.
I. Crank Shaft.
J. Wooden Lever.
K. Iron Knee.
L. Wooden Cross Bar.
M. Rods that move the frames.
N. Ventilators.
O. Pipe for filling tank and boiler.
P. Air-tube, to let the air out when filling the tank
R. Window glass.
S. Front door.
T. Lower tray.
U. Upper tray.
V. Window Shutter.
X. Heating plate, which goes clear across the bottom and is all in one piece.

The inventor says:—"It is self-regulating, and turns the eggs at proper intervals without any attention whatever, except to wind a clock. I claim to have as good a machine as can be made in other respects, and better in this, that no one else has the right to turn eggs by machinery. My machine has less work and fewer parts about the regulator than any self-regulating one made. The regulator is simply a long, thin bar, made out of the most expansive metal known, and made on an entirely new principle, which I have been allowed a patent on. This bar is connected with a small damper in the lamp box in such a way as to close and open it as the heat rises or falls, and turns the lamp up or down, as required.

"The heat can be turned on or off, at will, simply by turning the regulating screw A, to right or left. It works so perfectly that if the temperature is at all even, it will not need to be changed during a hatch. A change of thirty degrees outside of the machine makes one degree inside, which practically is nothing. The operation of the turner is as follows: The clock is so constructed that the crank H can be set to move at regular intervals. Each time it moves it makes a half turn and then stops, and the lever J moves the egg frames back and forth, and so turns the eggs. The frames move just far enough to roll the eggs upside down. The clock can be set to move as often or at any hour that is desired. The thermometer is hung inside, just over the eggs, and can be seen through the glass window R. The bottoms of the trays are of very open wire cloth, so that a free circulation of air is constantly taking place. Openings are provided at the bottom, in the coolest part, for the

escape of carbonic acid gas, while the draft of fresh air can be regulated to suit; as a given body of cold air being more dense than warm contains more oxygen, so less draft is required in cold than warm weather. My heat regulator is totally different from any one that ever was made. There is absolutely nothing to get out of order; it is always reliable. Electricity is very troublesome to keep in order, and is not always reliable, because unless a person understands it perfectly, it will not work at all. Besides, it is costly in the first place to buy a battery, and costly to run after you get it, while there is nothing that ever can wear out about mine, and nothing at all required but a drop of oil once a month to keep it in order.

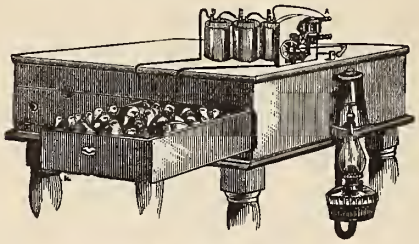
"The tank of my machine is of best galvanized iron; boiler and pipes are copper, and should last a lifetime, with proper care. The boiler and tank can be taken out any time, and repaired if they should need it. My machine can also be used as a hot air machine, if it is so desired, simply by leaving the tank empty, and it will hatch well either way. There is no other one that can be used this way.

"The construction of the whole machine is on scientific principles, and is very simple and easy to manage. The case is made double, with an air space for dead air, so as not to be easily affected by atmospheric changes. The heat is supplied by a No. 2 carbon oil burner The lamp is placed in a sheet iron box which is fast to a plate the full size of the outer edge, and is placed one inch below the case heating plate, which also is the full size of the machine, and all in one piece, so

that no gas from the lamp can possibly get inside. On top of this plate is the boiler, which is small and holds but little water, and it is connected with the tank at the top by a series of pipes, so that the top of the machine is slightly the warmest. The great advantage in having the heat both below and above is, that the lower part of the machine can be kept nearly as warm as the top, besides all the heat is utilized and none wasted. I have hatched 600 eggs with nine quarts of oil. The turner is very simple; the eggs are placed in the trays and rolled back and forth at regular intervals by a clock-work movement, which can be done as often as necessary or is wanted. All the air that goes into it is drawn in by pipes in a place for that purpose and is heated before it reaches the eggs. Moisture is supplied by evaporation.

"Another great secret of the success of my machine is, that I have studied and experimented until I know just what to do, consequently can tell others. Some of the other makers instruct to increase the heat, others to diminish at the last, and they are both wrong and right at the same time. But they all fail to note one very important point: There is an increase of heat during the last few days in natural incubation, and I have never yet seen it rightly explained where the increase of heat comes from. Some of them jump to the conclusion that the machine must be kept warmer, and others that it must be kept cooler, while the proper way is to do neither. The increase of heat is supplied by the chicks themselves and must not be done by the machine, and the cooling required must not be done by keeping the machine cooler, but by other means. If any one is inclined to doubt this, let

him take two eggs, one nearly ready to come out and the other set from four to eight days, and hold them alternately to your ear and see which is hotter, while both are taken from the same place."



THE ECLIPSE.

The Eclipse is manufactured in Waltham, Mass. The manufacturers write of it as follows:—

"Experience has proven that incubator tanks made of galvanized iron are not durable enough to justify their use in anything but a *very* cheap machine. We have discarded its use altogether in our tanks, which are now built of a composition metal got up expressly to resist the chemical action of water. Iron forms no part of this composition, and it can not rust. As the tank or radiator is the principal part of an incubator, any one can see at once how important it is to have a *durable* one. The Eclipse at the present time is the only incubator in the world that has the composition metal tank; consequently we warrant it to outlast any other.

"This tank is placed above the egg drawers, and is constructed upon an entirely new principle, by which a constant and uniform circulation of the water is secured, thereby making the temperature in the egg chamber the same in all parts. Our boilers are made of the best

cold rolled copper, and are very stiff and strong. They are unlike any other incubator boiler, having no seams that can not be got at readily should a leak occur, and like the tanks will outlast anything of the kind. In all other hot water incubators the tanks are made of galvanized iron, while the boilers are of copper. This is a fatal mistake, and a worse arrangement could not be had, as those two metals, being positive and negative, form with water a galvanic battery, the consequence of which is that the tank is very quickly destroyed by being perforated with little holes, 'rusted out,' apparently, long before it should.

"THE COST OF RUNNING

is very slight. The lamp consumes less than a quart of oil in twenty-four hours, and 105° is maintained easily in the coldest weather.

"By no possibility can the fumes of the lamp enter the incubator or reach the eggs. The fumes of the kerosene entering the egg chamber renders more than half the incubators on the market worthless. This applies particularly to those heated by hot air instead of water. We use the regular lamp-burner, as the insurance companies will allow no other.

"VENTILATION.

"Beneath the egg drawers, the bottoms of which are of wire netting, there are twelve ventilating pipes, always open to conduct to the *bottoms* of the eggs a supply of cool, fresh air—an absolute necessity. Whenever the valve opens (about once in 15 or 20 minutes), the outside air is drawn in, and when closed, these pipes carry out of the incubator the poisonous carbonic-acid gas generated

by the growing chicks in the shells. The gas is heavier than air and falls to the bottom of the incubator, where it is carried off precisely as water is carried off in a tile drain.

"MOISTURE.

"This is fully as essential as ventilation, and is provided for in the Eclipse by two large evaporating pans, which cover the entire bottom of the incubator. These pans are made to slide in and out of the machine, so the operator can change the water as often as need be without disturbing the egg drawers.

"ELECTRIC BATTERY.

"We use the Leclanche battery. This battery is ready for work in five minutes after setting it up, and will continue so for three years without any attention otherwise than putting a little sal ammoniac into the water. We not only use the Leclanche, but do it *without clock work.*

"As many persons have expressed a doubt as to the facility with which they could manage an electric incubator, and some have refrained from buying because they feared the apparatus might be too complicated, and require the services of an electrician to set it up, we would say that nothing would be more erroneous.

All you have got to do with this battery is simply to let it alone, and anybody can do this who tries. No one need fear the electrical apparatus of the Eclipse; first, because of its perfect simplicity; second, it is the only automatic regulator which can be depended on at all times; and third, because electricity has now come into such general use, for so many different purposes, everybody should know something about it. No other

argument is necessary to convince one of its comparative simplicity.

"In our application of electricity the moment the heat in the incubator reaches the point desired by the operator, the 'circuit' is closed by a thermostat. This opens a valve and enough of the hot air escapes to cool the machine one fourth of a degree, when the valve closes again; thus the eggs are saved from overheating, the bane of the usual artificial process of incubation.

"WOOD OR METAL CASES.

"It is hardly necessary to dwell on this subject as there is but one metal case machine now left on the market, all the other manufacturers having admitted the superiority of wood. The wood-work of the ECLIPSE is put together by a patent lock-corner dove-tail, making a joint so strong that nothing but a force capable of tearing apart the fibres of the wood can open it. We use only the best quality of lumber, thoroughly seasoned, and the top is kiln dried. The case is separated from the tank in such a way that the heat can not escape through the top, and the sudden changes in the temperature of the room in which it is kept can not affect the incubator. This is the great advantage which a wooden case has over a metal one, for almost as much care must be taken with the temperature of the room in which a metal incubator is kept, as with the temperature of the incubator itself.

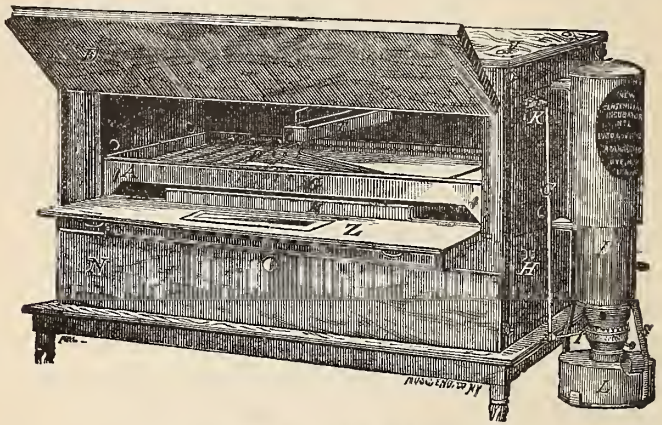
"We would suggest to our readers that in looking over the various circulars, if there is any disputed point which they are unable to decide for themselves, refer it to some disinterested person who is qualified to judge about it.

"The Eclipse is beautifully finished and is decidedly

ornamental. As it makes neither odor nor dirt, it can be set in a parlor or drawing-room, and in fact the house is the best place for it generally, as it is more convenient and easily taken care of there, besides costing less for oil.

"EGG TURNING DRAWERS

will be furnished hereafter with every incubator, so all the eggs can be turned in two or three seconds, saving time and labor."



THE NEW CENTENNIAL.

Of course there has been, is, and will be, competition in the business of inventing, making, advertising and selling incubators. This is what effects improvement. If competition is not the life of trade, it certainly causes much activity therein; so a person invents a machine, lays his hands on it and blesses it, calls it good; then straightway alters it or invents another, and calls this latter product *better*, perhaps simpler, it may be cheaper.

We notice that changes are made every year in

nearly all the most popular machines. These are the effects of experience, study, and the spur of competition.

The inventor of the Centennial gives to the world another incubator with the prefix adjective *new*, of which an illustration is given, and Mr. Halsted's description follows:—

"The new Centennial is a combination of the best points of the old centennial and the Acme, to which have been added a number of new features, and an entirely NEW REGULATOR.

"The Machine itself is in two parts; an inner case of galvanized sheet iron, covered by an outer casing of wood; with a dead air space between the two cases. It has double doors—an inner and outer one—the inner one being provided with a glass window through which to examine the thermometer and the eggs.

"The incubators are so put together that if a leak should occur at any time, they can easily be taken apart, the necessary repairs made, and the machine put together again without bruising or defacing the case.

"There is no electricity, no clock-work, no weights, pulleys, or double levers. A simple rock-shaft passes through the side of the machine, with a lever on each end of the shaft; one of which is connected with the Regulator, and the other with the lamp.

"A simple thumb-screw in the back of the machine, on the outside, adjusts the regulator to any required degree of heat.

"THE REGULATOR,

which is new and entirely different from that used by any other manufacturer, is placed above the eggs, out of

the reach of the young chicks. It is sensitive to the least change of heat, and very powerful; and instead of changing the flame from one extreme to the other—either very high or very low—as is the case in all other machines, it regulates the lamp to give the required heat. The action is regular and graduated to the needs of the machine: If in a very warm room, a low flame is produced; if the room grows colder the flame increases; and if the temperature of the room continues to fall, the flame grows larger until the full power of the lamp is turned on.

"VENTILATION

is provided for, by taking in a current of pure air, which passing close to the tank, is heated before it comes in contact with the eggs. It is then drawn to the four corners of the egg-chamber and thence carried by tubes outside of the machine. By this device the sides of the egg-chamber receive the same amount of heat as the center, and there are no cold-corners. The ventilation is constant, not fitful, and the air is always pure and sweet. The method of ventilating through an opening in the upper part of the egg-chamber has been discarded. In that system, the egg-chamber is alternately *overheated* by turning on the full power of the lamp, and then cooled down by opening the valve and allowing the hot air to pass off; thus making an unnecessary waste of fuel, as well as a constantly changing temperature.

"MOISTURE.

"The moisture, or evaporating pan is so placed that it receives a gentle heat from the return flue, and thus

supplies a moderate amount of vapor constantly under the eggs. The New Machine is provided with

TURNING TRAYS

by which all the eggs are turned in from three to five seconds, and without taking the tray out of the machine.

"The egg trays are all on one tier; not one above the other. It is a well known scientific fact that heat always rises, and that therefore it is impossible to keep a room or chamber at the same temperature at varying elevations. Hence a box or chamber heated to 103° at a certain height, will vary three to eight degrees at six inches above or below.

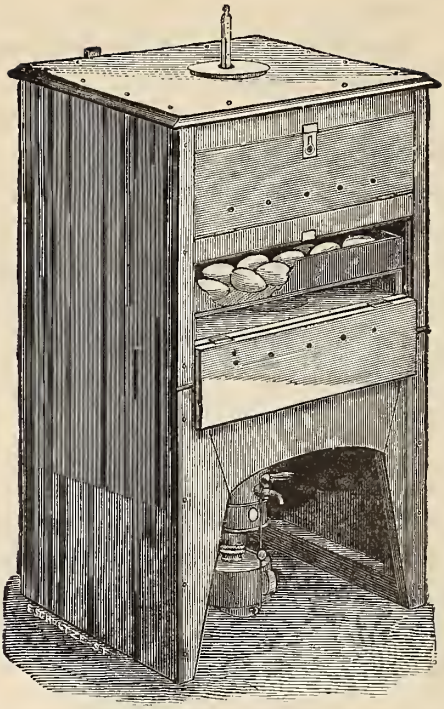
"FUEL.

"In economy of fuel the New Centennial is without a rival. The cost of hatching one hundred eggs will not be over thirty or forty cents in cold weather; and in late spring, or in a warm room, it probably will not cost half that sum.

"Under the egg-chamber is a

NURSERY OR BROODER

for the newly hatched chicks, in which they may be kept for a week, or longer, if desired. This is heated by the flue which carries the hot water from the tank back to the boiler, and supplies the heat to the chickens' backs as designed by nature—not under their feet, as is the case with many machines, making the chicks weak and sickly.



THE PACIFIC INCUBATOR.

This is a new invention, patented January, 1883. It has the peculiarity of being very simple in its construction, there being no electric battery, valve, engine, thermostatic bar, or other regulating apparatus; only a receptacle for water, warmed by the flame of a lamp. It seems evident that this makes an even temperature necessary in the room where the incubator is placed, or a climate in which no sudden changes to higher or lower temperature occur; unlike that which prevails in the Atlantic States.

But it is true that when the egg-drawers are mostly surrounded with heated water of the proper temperature, and of considerable depth or thickness, and the tanks covered on the outside with a thick sheathing of some non-conducting material, the influence of outside temperature will be only of slow effect upon the eggs, so that attention given once in a few hours will prevent a variation more than three or four degrees in the egg-chamber.

So it has been found possible to hatch chickens successfully without a lamp or oil stove; by simply drawing off water that has cooled, at intervals, from the tanks, and supplying its place by pouring in boiling water. As the water is heated by a lamp placed underneath, in the Pacific incubator, and there is no regulator, there is not so much expense in manufacturing and no time spent in regulating the regulator; but there must be a necessity of using time and the thermometer. Read what the manufacturer of the Pacific Incubator says. We print below his description and his reasoning: —

"The machine is made of the best galvanized iron, and well seasoned sugar pine, and the exterior case is finished to resemble a case of drawers. With reasonable care it will last a life-time.

"We are every day in receipt of letters asking if chickens hatched in incubators are as healthy and strong as those raised by hens; and have no hesitation in saying, that where the proper conditions have been complied with, they will come out stronger and healthier. Artificial hatching is very simple in itself, the sole requisites being a proper temperature, fresh air and moisture enough to

prevent the evaporation of the contents of the egg through the shell.

"To supply these conditions an almost endless number and variety of machines have been invented, most of which have failed entirely or in part to accomplish the end sought for.

"To obtain an even temperature has been the absorbing aim of most experimenters, and the equally important matter of fresh air and moisture has been imperfectly understood and more or less overlooked.

"Chicks hatched in hot, foul air are always weak, puny and unhealthy, and will never repay the trouble and expense of raising, most of them dying before maturity.

"There are various methods in use for supplying the eggs with heat; one is, by actual contact; another heats the air before forcing it into the egg-chamber, and a third is by radiation and attraction.

"All experiments with contact heat have signally failed, the hen tolerating no imitators of the natural and primitive way.

"The hot air plan is very objectionable for various reasons: 1st. Hot air is not pure air; the hotter the air the less vital life-giving principle it contains, and we claim that hot air is as injurious to animal as to plant life. The consumption of fuel in all hot air machines is very great, as much of the heat is wasted.

"The other method is to supply the eggs with heat by radiation and attraction.

"There is a natural attraction between life and heat, which is but little disturbed by currents of air passing

between them, so that if the eggs are placed in close proximity to a heated body, the living embryo will absorb and attract the heat, notwithstanding the cool fresh air around and about the eggs.

"The Pacific Incubator is constructed upon this plan, and a perfect circulation of hot water has been obtained, thus insuring a uniform heat in all parts of the machine. Without perfect circulation, uniform heat is impossible. As a consequence, chicks so hatched are strong and hardy, and mature quicker than those hatched by hens.

"REGULATION OF HEAT.

"The next point in artificial hatching is to keep the temperature reasonably even, for which purpose all the so-called self-regulating contrivances have been invented, all of which are so complicated and get out of order so easily that no dependence can be placed upon them. When the regulating machinery has to be set in motion by one or two degrees of extra heat, it follows that a correspondingly small force will stop it, and as it requires adjusting from time to time, whether out of order or not, it will readily be seen that these contrivances are self-regulating only in name.

"The Pacific Incubator has no machinery or electric battery to get out of order.

"It is constructed in a series of egg-chambers surrounded by galvanized iron tanks filled with water heated by the boiler below and kept in constant circulation as long as the lamp is burning. The eggs are placed close to the water tanks above them and set on trays with strong galvanized wire bottoms. A strong current of fresh air constantly passes through the chamber under-

neath the eggs, carrying off the carbonic acid gas thrown off by the embryo from time to time.

"MOISTURE

is supplied by wet sponges under the egg-drawers, the evaporation from which is continuous, and is in exact imitation of nature, the heat from the hen's body drawing moisture from the ground where she makes her nest in a wild state.

"THE TEMPERATURE

is indicated by a thermometer placed in the top of the tank, the ball of which is in the water, and is easily regulated by turning the wick of the lamp up or down as may be needed. The great amount of water contained in the tank makes a steady heat, and consequently it requires very little attention, *and there is absolutely no necessity for touching it during the night.* This matter of regulation may be relied upon, as the machine has now been in use two years, and we have yet to hear of a complaint in that direction."

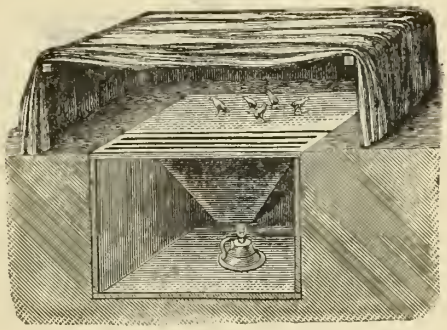
This incubator is manufactured at the Oakland Poultry Yards, California.

We give plan of a glass-house used for the raising of young chicks at those yards. Its dimensions are as follows: In length, 20 feet; width, 10 feet; height, 9 feet; and it is divided into five compartments, each of which is supplied with a Brooder (see illustration page 57), and each compartment will accommodate 150 young chicks.

This building may be built as a lean-to against the sunny side of a barn, or in any way to suit the surroundings, but must be warm, tight and have good ventilation for warm weather. By keeping older fowls away

from the glass-house, vermin will be altogether avoided.

"The dimensions of the Pacific Brooder are as follows: Length, 36 inches; width, 24 inches, contained in a box 16½ inches deep, which is set into the ground, so that the top of the Brooder is flush with the surface.



PACIFIC BROODER.

"This is covered by a curtain of burlap falling from a light frame-work nine inches high. (See illustration above.)

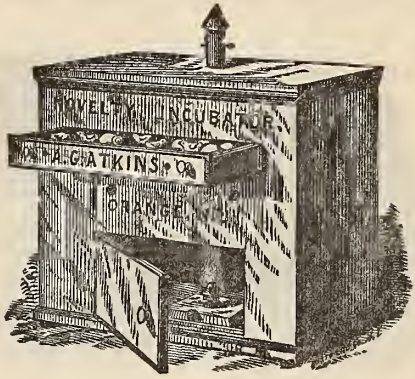
"Hitherto most Brooders have been so arranged that the heat came from the top, causing the young chicks to crowd and under-run each other in their efforts to reach the heated surface. Frequently half the chickens of a hatch would be smothered or trampled to death in these old-fashioned brooders.

"The Pacific Brooder was designed to remedy this trouble, and has effectually accomplished the purpose.

"The heated air coming from beneath and being distributed uniformly over the whole surface of the brooder, there is nothing to cause crowding; and upon lifting the

curtain the chicks are found nestling close to the heated floor and spread over its whole surface.

"The surface of the brooder should be sprinkled lightly with dry earth or sand."



THE NOVELTY INCUBATOR.

This incubator is similar to the Pacific in arrangement, and in the absence of any regulating machinery, as the illustration shows. Of course it is not high priced. Read what Mr. Atkins, the proprietor, says of it, and of the science of hatching:—

"1. As the life-germ in the egg floats on the top of the egg, and also, in accordance with nature, as the top comes in contact with the warm breast of the hen, the heat on the top must be about 2½ degrees Fah. greater than the heat on the bottom of the egg.

"2. The heat must be uniform over the eggs—no greater in one part of the egg-drawer than in another—and it must be steady and without fluctuations.

"3. The egg-drawer must be thoroughly ventilated,

without, however, chilling the eggs. Without plenty of fresh air, inevitable failure is the result.

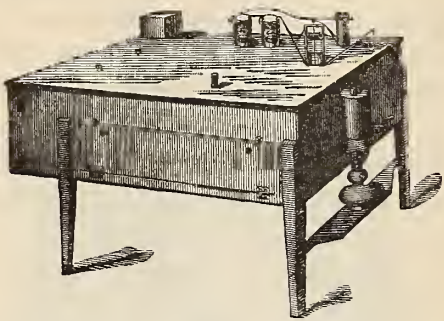
"4. Moisture must be applied during the hatching process, and moisture by evaporation is considered best.

"A machine that fulfils these conditions is likely to give satisfaction, and will be a mechanical success. To insure its commercial success and bring it within the reach of the many who desire to substitute machines for hens, the incubator must be simple in construction, capable of being managed by any person of ordinary intelligence; it must be economical, consuming not over three cents per day for fuel; it must be perfectly reliable, hatching as large a percentage of the eggs as can be hatched by hens under the most favorable circumstances; and, lastly, it must be furnished for a small amount of money.

"In the Novelty Incubator it is believed that all these conditions are fulfilled.

"By the use of two tanks connected by vertical circulating pipes, a perfect circulation and uniform top heat over the eggs are secured. As these tanks contain a large quantity of water, are thoroughly felted and incased in a case an inch thick, made of well-seasoned wood, when the temperature in the egg-drawer is raised to the required point, the changes, whether up or down on the thermometric scale, are very slow and gradual. 'A little pot is soon hot,' and soon cold, too, but the Novelty maintains its temperature most satisfactorily amid all the changes of our variable climate. All the care that is necessary is to turn up or down very slightly, as may be needed, the flame of a common kerosene lamp, which is

placed under the lower tank. An inspection of the machine will show how perfect ventilation is secured. There is absolutely nothing to get out of order and give trouble."



THE WHITE MOUNTAIN INCUBATOR.

It is well to read first what the inventor or manufacturer of a machine writes in the way of description. Those who make incubators that are similar in construction, using the same methods for heating the eggs and regulating the temperature, give us similar descriptions, so that one descriptive circular might be used by several manufacturers without much alteration. Slight alterations or improvements are worth noting. That is true. Men will alter if not improve their own work from time to time. The task of describing ones own machine is a pleasure in most instances, so in the description of the White Mountain Incubator we will make room for Mr. E. E. Bishop: —

"Part of the chimney extends into the concave bottom of the boiler, which is so constructed that but very little heat is lost. The combustion is perfect, so there is no cleaning of the bottom of the boiler every day or

so, as is the case with some machines. The top of the boiler is fitted with a tight-fitting cover, by removing which the depth of water in the boiler may be easily seen. As the boiler is on the outside of the case, the fumes of the lamp can not enter the incubator. Inside the machine are two tanks, one over the egg-chamber and one over the end drawer. These tanks are so constructed that the parts which would naturally be colder are given extra circulation thereby producing uniform temperature in the drawers below. The water after making the circuit of the tanks is brought back to the boiler again by return pipes and after being reheated is carried by pipes into the tanks again. The loss of water from evaporation will not be more than a pint in four or five weeks. From the main tank there is a small tube that projects to the outside of the case. Into this tube a thermometer is inserted so that the temperature of the water can easily be seen. The main tank covers nearly all the space above the egg-drawer, so there are no cold corners. There is also a piece of wood fitted under the egg-drawer thus making, as it were, an inner door with an air space between it and the outer door. At the left of the door are certain parts auxiliary to the machine proper. First, there is a narrow tank running the width of the machine. This tank is supplied with water from the main tank, beneath this tank and warmed by it is an end drawer in which eggs are placed to be warmed up to the temperature of the main drawer. Eggs that are about to be hatched are also placed here and the chickens are allowed to remain until dry and strong.

"MOISTURE.

"Beneath the end drawer is the moisture pan which is supplied with fresh water from the small tank. From this tank water is constantly dropping and spraying into the moisture pan below. As soon as the water rises to such a point in the moisture pan it drops into a small tank which is suspended beneath the machine; from here it can be emptied into another tank whenever the water has run out. The water does not need changing more than once in one or two weeks. All the air that enters the machine first passes over the moisture pan; (into which as before stated the water is constantly dropping, spraying,) here it becomes thoroughly moisture-laden before entering the egg-chamber. This system of supplying moisture is vastly superior to that generally used by other makers, who have the moisture pan under the egg-drawer; when there placed the water must be changed every day or two and if a chick should happen to get under the drawer it is sure to get into the water and get drowned. It is also very injurious to the machine, as the wood absorbs the moisture and being subject to so high a degree of heat, soon gets musty and strong, and the machine is liable to warp; but with my system of supplying moisture all these objections are done away with.

"VENTILATION.

"The air after entering the moisture-chamber and becoming thoroughly moisture-laden is carried by a series of pipes into the egg-chamber, and evenly distributed to all parts thereof. The bottom of the drawer is of wire netting, so that every egg in the drawer has a full supply of fresh and moistened air. A constant top ventila-

tion is provided by means of a ventilator also at a large tube whenever the valve is open. All the heavy gases that settle to the bottom of the egg-chamber are drawn off whenever the door is open. So the air in the egg-chamber is always pure and free from all unpleasant odor and all parts of the egg-chamber constantly supplied with a full supply of fresh and moistened air.

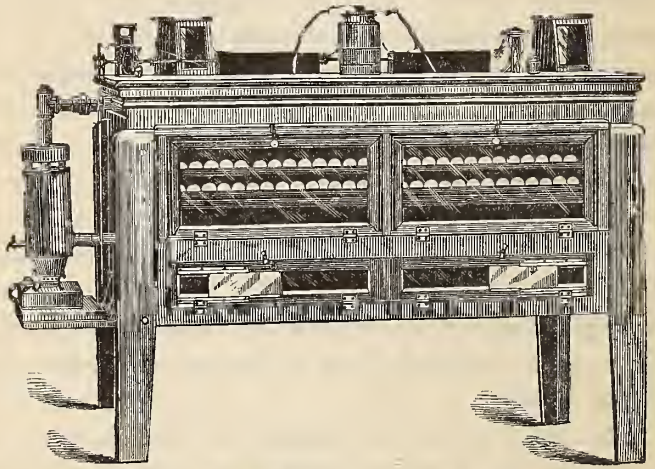
"THE REGULATOR.

"This Incubator, as now made, has a pyrometer that works very accurately. It is placed in front of the egg-chamber and where it is out of the way, and the thumb-screw can be set at any desired temperature. The batteries are very simple and durable, and will last two or three years without renewing. I also use a larger valve than is shown in the cut, and the magnet is in a different position (it lies down instead of standing as shown), and the levers, etc., are brought more compact. The regulator controls the heat perfectly and is sure to work.

"In my egg-turning trays I use the wire netting bottom, thus giving perfect ventilation. The eggs lie between bars running across the drawer, and are turned by simply turning a crank at each end of the drawer; no waste space in the drawer."

In regard to artificial brooders, Mr. Bishop says: "No matter whether chicks are hatched naturally or artificially, a brooder will surely pay. When it is used there is no hen to trample the chickens to death, take them out into the wet grass, or pick up all the choice bits that may be given them. It is now a very common practice among those that hatch chicks under hens, to raise them artificially, as the hen can then be given another sitting of

eggs, or be broken up so as to be ready to go to laying again. It is no more work to raise chickens, without the aid of the hen, than with it, and by the use of the Brooder, there is perfect freedom from lice, and a greater per cent. of the chicks can be raised. My brooders are all heated by a tank of hot water, running the length of the brooder on the back side. The bottom of this tank is covered with flannel, beneath which the chicks hover. The front is of glass so as to give chicks full benefit of the sun and light, and both front and back are sloping so no water can remain on them."



THE PERFECT HATCHER.

The following brief description by the proprietors of this machine will give some idea of its construction and operation :

"The conditions for successful hatching are the perfect automatic control of heat, moisture and ventilation. In

the 'Perfect Hatcher' the heat is controlled with automatic precision by means of a very sensitive thermostat, acting through the agency of electricity upon a motor that turns the heat on and off and opens and closes a valve in the egg-chamber for the escape of any surplus heat.

"The proper amount of moisture is automatically obtained from open pans of water resting upon hot water pipes. The evaporation is regulated in exact proportion to the size of the egg-chamber and the varying conditions of the atmosphere.

"The automatic ventilation is secured by the frequent opening and closing of the valve, permitting an influx of fresh air and expelling that which has become impure, thus rendering the atmosphere of the egg chamber at all times as pure as that of the room in which the machine is placed.

"The superiority of material and workmanship, absolute automatic control of temperature, by acting directly on large valves and the flame of the lamp, and a scientific combination of all conditions necessary to successful incubation, entitle the Perfect Hatcher to the leading place among incubators voluntarily given it by hundreds of its patrons.

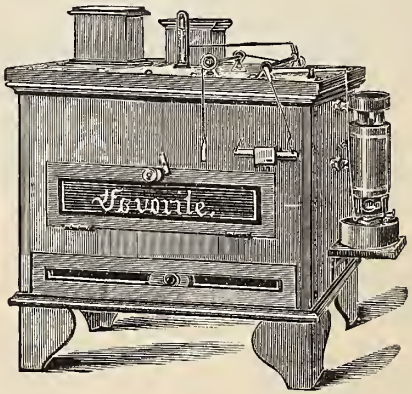
"Its wonderful success in hatching a larger per cent. of eggs than the natural hen, and the ease with which it is managed render it especially adapted for work on a large scale, which has been fully proven by the many sales to parties who are now using hatchers with capacity from 900 to 2200 eggs for commercial purposes.

"Its automatic safety alarm will, invariably, notify the operator in case of any accident or meddling, and its

magnificent (!) resistance to outside changes causes it to work equally well in a temperature of zero or 100 degrees."

Nearly all the most prominent manufacturers of incubators also supply brooders: these contrivances being absolutely necessary where large numbers of chicks are hatched at one time. These brooders generally take the names of their illustrious predecessors. The description which we have obtained of the Perfect Hatcher is somewhat brief, but laudatory.

"The 'Perfect Brooder' is so constructed as to afford a very close imitation of the action of the hen while brooding over her chicks. The arrangement consists of hot water pipes encased in wood and covered with flannel. The whole is protected by a glass roof, and there is an extended run covered with glass. The brooder actually affords more comfort and greater security than is furnished by the natural method.



THE FAVORITE INCUBATOR.

This machine was formerly manufactured by Hebbard Bros., of Knoxville, Tenn., but has passed into the hands of Mr. P. H. Jacobs. We have received a description of it which will give an idea of the construction, and which we insert below :—

"THE CASE.

"A great deal of time and expense has been incurred to enable us to produce a combination that would offer the greatest resistance to heat and cold, and in this we have been very successful, having adopted an inner case that is made of thoroughly seasoned wood, which is enclosed in a handsome black-walnut outside case, with an inch dead air space between the two. This walnut case is finished in oil, giving the machine an elegant appearance and making it an ornament to any room. In fact the FAVORITE can be found in the sitting-rooms and kitchens of many of our breeders and fanciers, it causing no inconvenience or smell, being as odorless as an ordinary kerosene lamp.

"While we have built this machine in a neat and tasty manner, without making it a sheet-iron eye-sore on stilts we have also overcome the great defect to be found in iron-case machines, as by our mode of construction, the non-conducting power is so great that a variation of many degrees in the outside temperature will not affect the heat in the egg-drawer in the least. This point we can not too strongly impress upon intending purchasers, and should not be overlooked, for there are many machines, which from the manner and style of their construction, render the means of heating inadequate to keep up the temperature, whenever there happens a very

cold snap of weather, and it is necessary to put padding around them, or cover them with blankets. Nothing of the kind is required with the FAVORITE.

"THE HEAT.

"This Incubator is heated by means of hot water in a galvanized-iron tank, attached to which is a copper heater, the lamp chimney being a copper flue passing directly through the water; consequently, the heating power is very great for the amount of oil consumed, the tank covering the whole upper part of the egg-chamber and deflecting the heat directly to the top of the eggs, which is, in our opinion, the only correct method, and nearest in imitation of nature. The arrangement for circulating the water in the tank is perfect, and always insures uniform heat in every part of the egg-chamber, as eggs in the corners or sides will receive precisely the same heat as those in the middle, which is a very important feature, and obviates the necessity of constantly changing the eggs from one part of the egg-drawer to another; this is an advantage which we possess over all machines, with possibly one exception. The water after circulating through the tank, passes down through the pipes at the corners, and then through a coil of pipes which encircle the space in the bottom of the egg-chamber, directly beneath the evaporating-pan; it is then carried to the botton of the heater, reheated and returned to the tank, thus completing the entire circuit. These pipes serve other distinct purposes, which will be explained under the head of Moisture and Nursery.

"MOISTURE.

'In this machine, the moisture, which is continuous,

is supplied in just sufficient quantities to produce the best result, and is an exact imitation of nature. The application is by means of open pans of water, placed directly beneath the egg-drawer on the pipes in the bottom of the egg-chamber, the water in the pans being warmed by pipes sufficiently to cause just enough evaporation to overcome the dry heat, and to temper and soften the air. In most of the machines now in use, pans of cold water are placed under the eggs, but as this does not evaporate sufficiently, it is necessary to sprinkle the eggs with warm water once or twice each day, in order to give the growing germ the requisite amount of moisture.

"REGULATOR.

"The regulator governing the heat in this Incubator, is always positively reliable, being composed of a group of bars in the top of the egg-chamber, and made of a material that is very sensitive to heat and cold; its action is positive, opening and closing the ventilator, and graduating the flame of the lamp, thus effectually checking the advance or decline of the temperature. The mechanical part is regulated by a thumb screw on the outside of the machine, which allows the temperature in the egg-chamber to be fixed at any desired point. When properly adjusted, the expansion bars affected by the heat, act upon an escape lever, releasing an arm, which passes from one side of the lever to the other, at the same time turning down the lamp flame, and opening the ventilator, allowing the hot air to escape from the egg-chamber. It remains in this condition until the heat has fallen one-half to three-fourths of a degree,

when a reverse action of the escape lever occurs, causing the arm to return to its former position, the ventilator to close, and the flame of the lamp to be turned up; this movement takes place every fifteen to thirty minutes, and goes on continually, by means of power transmitted by a simple reel and weight.

"We do away with all clock movements, with its complicated machinery, and use a simple mechanical device, that is made strong and durable, at the same time working easy, requiring but an ounce weight to supply the motive power.

"NURSERY.

"This is a feature that will be much appreciated by those who have been troubled to know what to do with the chicks that are just hatched, and are too wet and weak to be placed in the brooder, but strong enough to struggle about the egg-drawer, to the great inconvenience and sometimes fatal injury of the chicks that are only partially extricated from the shell. It is placed in the lower part of the machine, and is lighted by a glass-door; the temperature is nearly the same as in the egg-chamber, it being heated by the circulating pipes which pass under the evaporating pan, making it a cosy little apartment in which the chicks may become thoroughly dry and gain sufficient strength before placing them in the brooder."

RENWICK'S THERMOSTATIC INCUBATOR.

Probably no man in this country attempting the invention of an incubator has brought so great an amount of scientific and mechanical knowledge to bear upon the subject as Mr. E. S. Renwick, the inventor of the

"Thermostatic." There is an appearance of much machinery about this incubator, which, at first sight, every

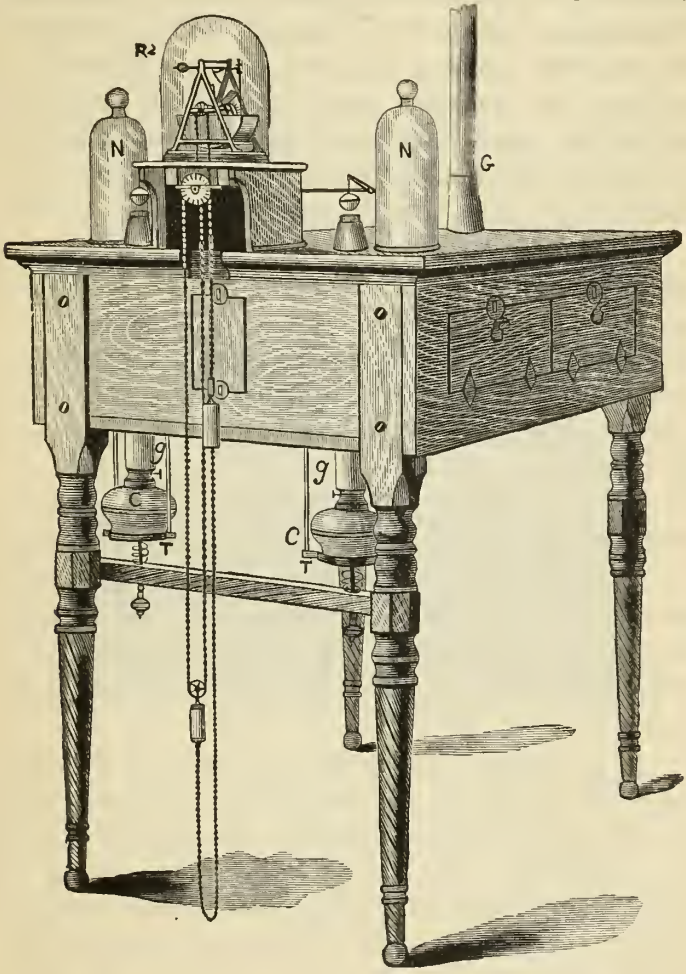


FIG. 1.

one will not understand, but if machinery is necessary to make automatic action perfect no one should be fright-

ened; for we know that in other things besides egg-hatching the finest and most perfect work is accomplished by mechanism which the uninitiated fail to understand. Mr. Renwick furnishes the most complete directions for working his incubator and very minute description of all its parts. We are obliged to condense the material at our disposal. The inventor's book, "Thermostatic Incubator," tells the whole story.

"The eggs are supported on rollers arranged in four egg-trays, two at the back of the machine and two at its front. The rollers of each tray are connected so that all the eggs in each tray are turned simultaneously. The inventor of this Incubator is the only person authorized to use this system, he having the foundation patent No. 224,224.

"All the egg-trays are arranged in one layer, so that the heat acting upon the eggs is practically uniform.

"Turning trays, such as those generally used, may be adopted in this machine. These trays are less expensive to make than the patent roller trays, and allow for an increase in the capacity of the machine to 216 or 225 eggs.

"The heat is supplied by two lamps, C C, and is circulated through the Incubator partly by air and partly by hot water circulating through the evaporators. The heat is regulated by a tension thermostat which controls a weight by which valves are opened to allow the heat to waste when the heat rises too high; the valves being closed when the heat falls. *No electrical apparatus of any kind is used*, but a simple clock weight, which is wound twice a day, like the weight of a Cuckoo clock,

by pulling a chain. *Moisture is supplied automatically* by two water fonts, N, which deliver the water into evaporating pans within the Incubator, and the quantity used is in proportion to the requirements of the Incubator.

"The top of the Incubator measures four feet long, and two feet and ten inches broad; and the Incubator contains the heat flues, evaporators, egg-trays and thermostat. The valve engine is supported on top of the Incubator, and has an iron frame. The ventilation is automatic. The air is heated as it enters at the lower

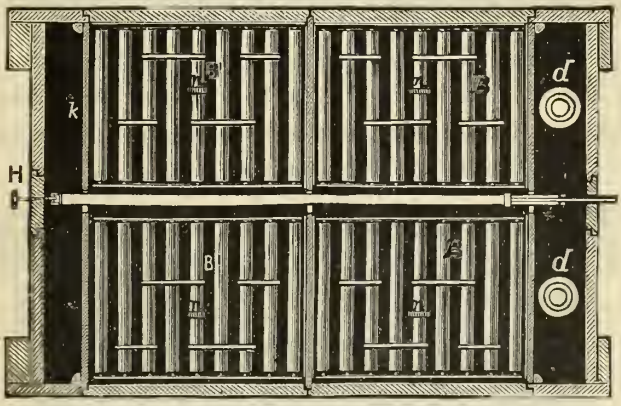


FIG. 2.

ends of the heaters inside the Incubator and is discharged over the tops of the eggs. Thence the air *passes down* through the egg-trays and *is drawn off from beneath the eggs;* thus accomplishing a downward circulation which keeps the tops of the eggs warmer than their underside, supplies them with fresh air, and removes the carbonic acid gas."

In reference to the cuts illustrating this Incubator, Fig. 1 is a perspective view. Fig. 2 is a horizontal

section of it above the egg-trays. Fig. 3 is a vertical longitudinal section of the incubator through one of the waste heat chimneys. Fig. 4 is a plan of the incubator

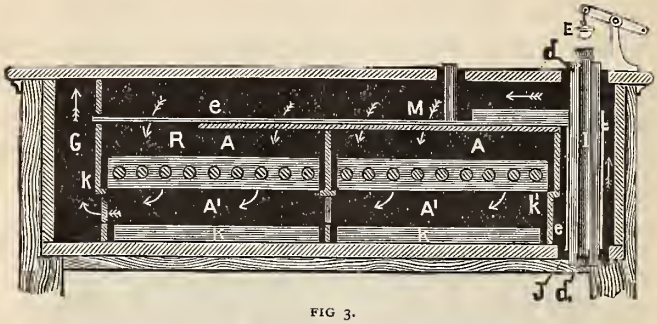


FIG 3.

with the top removed. Fig. 5 is a central vertical longitudinal section of the incubator. Fig. 6 is a view of the end at which the valve engine is arranged.

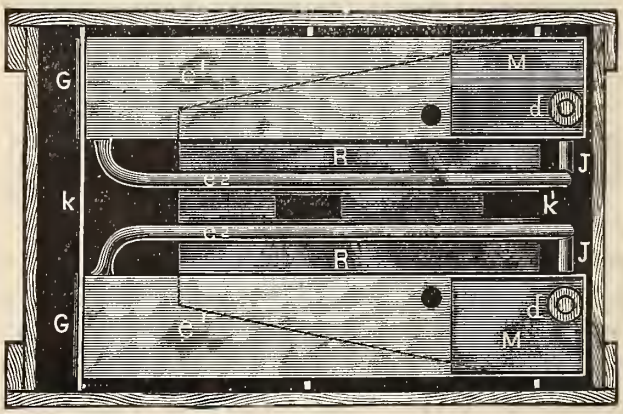


FIG 4.

"The thermostat. This is a species of thermometer using the expansion of a solid in place of the expansion of a liquid to indicate variations of temperature. The

first thermostat used by the author was a compound bar composed of two strips of vulcanite and brass riveted together, and various improvements were devised to render the implement sensitive and certain in its actions. The thermostat now used, while sufficiently sensitive in its action, can be afforded at a less price than the compound bar, and its construction is based upon the different longitudinal expansions of vulcanite and dry wood or equivalent material. It consists of a strip of vulcanite, *s*, Fig. 5, strained longitudinally upon a frame composed of two wooden bars, *t t*, and of the metallic connections, *u*, of those bars. The strip is about thirty-nine inches long, and the difference in expansion between it and the wooden bars is multiplied by two levers V^1 V^2, the last of which is connected by a rod, *l*, with the lever arm, *w*, of the detent, Z, of the valve engine. The weight of the longer arms of the levers and of the rod, *l*, is more than counterpoised by the weight, U, so that the strip of vulcanite is constantly under longitudinal tension, and the play or loose fitting of all the connections is taken up. The thermostat is set in the middle of the incubator between the backs of the front and rear drawers or trays, so that it is exposed to the variations of temperature which affect the eggs. The longitudinal expansion of the vulcanite by an increase of heat in the incubating chamber permits the weight, U, to move the detent, Z, of the valve engine downward; and the contraction of the strip incident to a decrease of heat raises the weight, U, and moves the same detent upward.

"The lamps, C C, by which the heat is supplied, have ordinary kerosene burners and short tin chimneys,

g, each fitted with a pane of mica to permit the flame to be inspected. The lamps are trimmed and filled in the common way. Each lamp is supported upon a movable spring lamp gallery, T, which can be depressed to disengage the lamp chimney from the flue above. To remove the lamp for filling and trimming, the operator should grasp the lamp font with one hand and should pull the gallery downward with the other hand sufficiently to disengage the lamp chimney from the flue above it; then he should lift the lamp out of the cavity of the gallery and draw it toward him, after which the lamp gallery should be allowed to rise gently. The wick should be trimmed slightly rounding. The lamp fonts are purposely made of large size, so that they will hold kerosene enough for forty-eight hours, in case the operator should some day forget to fill them. The size of the lamp burners depends upon the temperature of the room in which the incubator is used. If the temperature of the room does not sink lower than 65° Fahrenheit, the ordinary 'A' burners may be used with advantage. If, however, the temperature of the room is liable to run down below 65° Fahrenheit, 'B' burners should be used; care being taken that the wicks are not turned up too high. The lamp fonts will admit of the use of burners of either size, reducing rings being used to accommodate the rings of the fonts to the dimensions of the screws of 'A' burners. The only objection to the use of the larger ('B') burners at all times is the risk of burning more kerosene than is necessary, and the consequent waste of oil. If, however, care be exercised in the adjustment of the wicks, a little practice will enable the

operator to use the 'B' burners without waste of oil, whether the room be warm or cold; but if the incubator be put to work in this latitude during the winter season, it is perfectly safe to start with 'B' burners and to change the burners when the warm weather in May commences.

"The ventilating chimney is located at the end of the incubator which is furthest from the lamps. A part of it is within the casing, being formed by the partition, *k*; the residue projects above the top of the incubating chamber. It connects by openings through the lower part of the partition, *k*, with the incubating chamber beneath the perforated bottoms of the egg-holders or trays. Hence while the hot air enters at the top of the incubating chamber at one end of it, the foul or colder air passes into the ventilating chimney from the bottom of the opposite end of the chamber, and consequently there is a downward circulation of the heated air through the egg-holders and incubating chamber. This downward circulation tends to equalize the temperature in horizontal directions, while it causes the upper sides of the eggs to be hotter than their under sides, thus corresponding with the application of heat from the body of a hen in natural incubation.

"The ventilating chimney also receives the spent gases from the vent pipes, *a*, of the heat flues, so that it is always kept warm by such gases, and consequently has a good draught. If, however, the draught should not prove sufficiently active in hot weather (when but a comparatively small quantity of heat is furnished by the lamps) to insure the requisite circulation of air, a piece

of pipe two feet in length may be applied to the upper end of the ventilating chimney so as to lengthen it.

"The evaporators consist of two pans (M M, Figs. 3 and 4,) located in the upper part of the incubating chamber at the heads of the upright portions of the heat flues, *d d*. Their office is to supply moisture to the air, thus preventing the drying of the eggs. Each

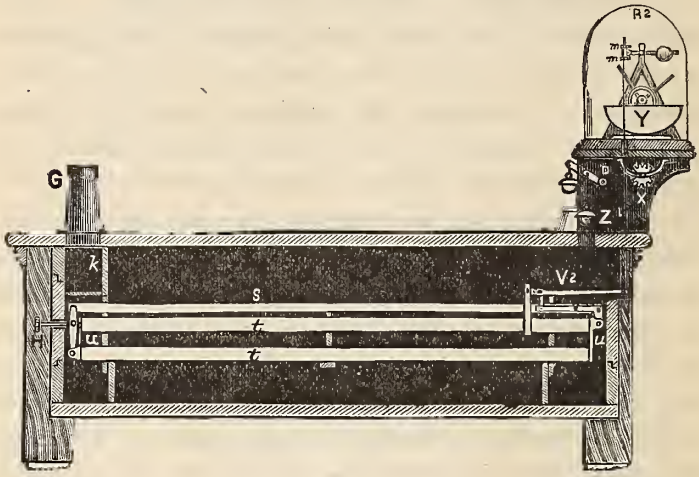


FIG. 5.

evaporator is supplied by a font, N, Fig. 1, having a feed pipe projecting from its bottom and passing downward through a hole in the top of the incubator, into its appropriate evaporating pan. There is automatic action. The water escapes whenever the level of the water in the evaporating pan sinks low enough to unseal the nozzle of the font.

"Fresh air is introduced through supply pipes surrounding each lamp flue, *d*. The fresh air from the air supply pipes is discharged into the upper part of the

incubating chamber beneath the evaporating pans, M; and the air is heated as it rises, by the radiation of heat from the upright lamp flues, *d*.

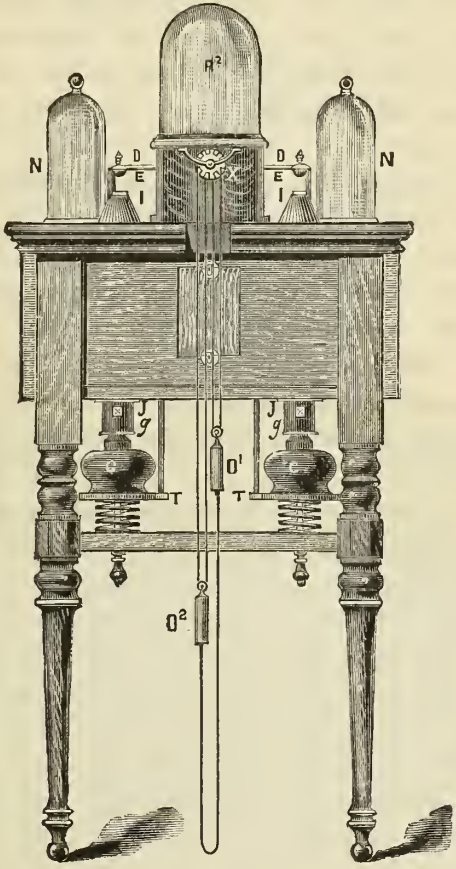


FIG. 6.

"The end of the incubator at which the valve engine is situated is represented by Fig. 6. There is one waste-heat chimney for each lamp, each chimney extend-

ing through the lamp flue and passing out of the top of the incubator, where the chimney is fitted with an acorn-shaped drop valve, E. When this valve is lowered, the chimney is closed, the waste of heat is prevented, and the heated gases from the lamp are compelled to pass through the lamp flues, *d*, *e* e^1, and to heat the incubator. When the valves are raised, the waste-heat chimneys are open, and the greater part of the heat from the lamps escapes, thus permitting the incubator to cool. Hence the opening or closing of the valves of the waste-heat chimneys determines the heat of the incubator; and this opening and closing is effected automatically by the valve engine as controlled by the thermostat.

"The valve engine is represented in Figs. 7 and 8. It is mounted upon a pedestal at the top of the apparatus, and is covered by a removable glass shade, R^2. Its main shaft, W, Fig. 7, is fitted at one end with a crank, P, whose wrist pin is connected by means of a connecting rod, *b*, with an arm projecting from the valve shaft (D, Figs. 5, 6 and 7) beneath the valve engine. This valve shaft extends across the top of the incubator and is fitted at its ends with arms from which the drop valves, E, are suspended. The weight of the valves and arms of this rock-shaft is counterpoised, so that a very small force is required to move the valves.

"The valve engine is driven by a weight hanging upon a chain which passes around the chain pulley (O, Fig. 7,) on the main shaft, W. The chain is endless, and is divided into two loops by the winding pulley, X. Each loop holds a weight; the larger (o^1) of which furnishes the force for driving the engine, while the lighter

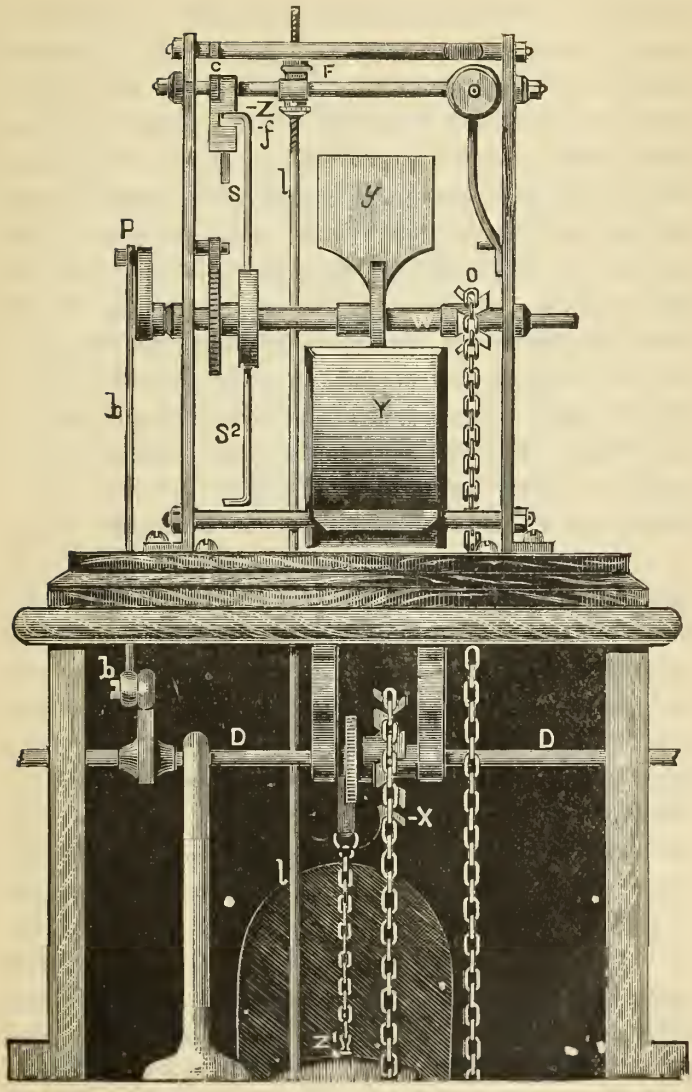


FIG. 7.

weight, o^2, tautens the chain. As the heavier weight runs down in working the valve engine, the lighter weight is drawn up, and if the heavier weight should be permitted to run down to the floor, the further movement of the valve engine would be prevented. Hence the heavier weight must be wound up periodically, generally every morning and evening, the winding being effected by taking hold of the strand of chain which extends from the lighter weight o^2 (Fig. 6) to the winding pulley, X, and pulling it downward; the operation being repeated until the heavier weight is wound up close to the winding pulley. Care must be taken that the loops of chain are not twisted, and are not out of the pulleys of the weights or the winding pulley; either of which contingencies would render the valve engine inoperative.

"The valve engine now used is less sensitive in its action than the most perfect one which the author has produced; but the loss in sensitiveness is compensated by simplicity, while the sensitiveness is sufficient to cause the engine to operate with a change of 3° of temperature. Those who desire a detailed description of a valve engine so sensitive that it will operate with a change of half a degree of temperature, will find it in the author's American patent, No. 210,559, dated December 3d, 1878, a printed copy of which may be procured from the Patent Office.

"The speed controller consists of a four-armed paddle-wheel, *y*, Figs. 5, 7, and 8, revolving in a trough, Y, containing a liquid. Its office is to prevent the valve engine from moving too rapidly and stopping

with a jar. The trough should be filled with oil or glycerine.

"As the lamps and the evaporators are both at the same end of the incubator, and as the heat of the flues must therefore be progressively less as they extend toward the opposite end, while the air admitted for ventilation also tends to cool down in its passage from the vicinity of the evaporators onward and downward to the lower end of the ventilating chimney, the incubator should be hottest near the lamps, and the heat should be progressively lower toward the ventilating chimney. This is the natural tendency; and to obviate it, the heat distributor, R, is provided. This distributor consists of a diaphragm of pasteboard, or other material, arranged horizontally between the undersides of the horizontal flues, e e^1, and the open tops of the egg-holders beneath. The diaphragm is partly cut away so as to permit the descent of the warm air and the moisture carried by it; and the removal of portions by cutting away is greatest over the drawers which are furthest from the lamps. The operation of this distributor is to obstruct the direct downward passage of all the warm air through the drawers that are nearest the lamps; to cause a large portion of the hot air to move along over the distributor to the drawers that are farthest from the lamps; to obstruct the direct radiation of heat from the portions of the horizontal flues, e e^1, that are nearest the lamps; and by the above operations to distribute the heat more equally than it would be otherwise. The substance which we prefer to use as the material for the heat distributor is what is commonly called heavy tar-board,

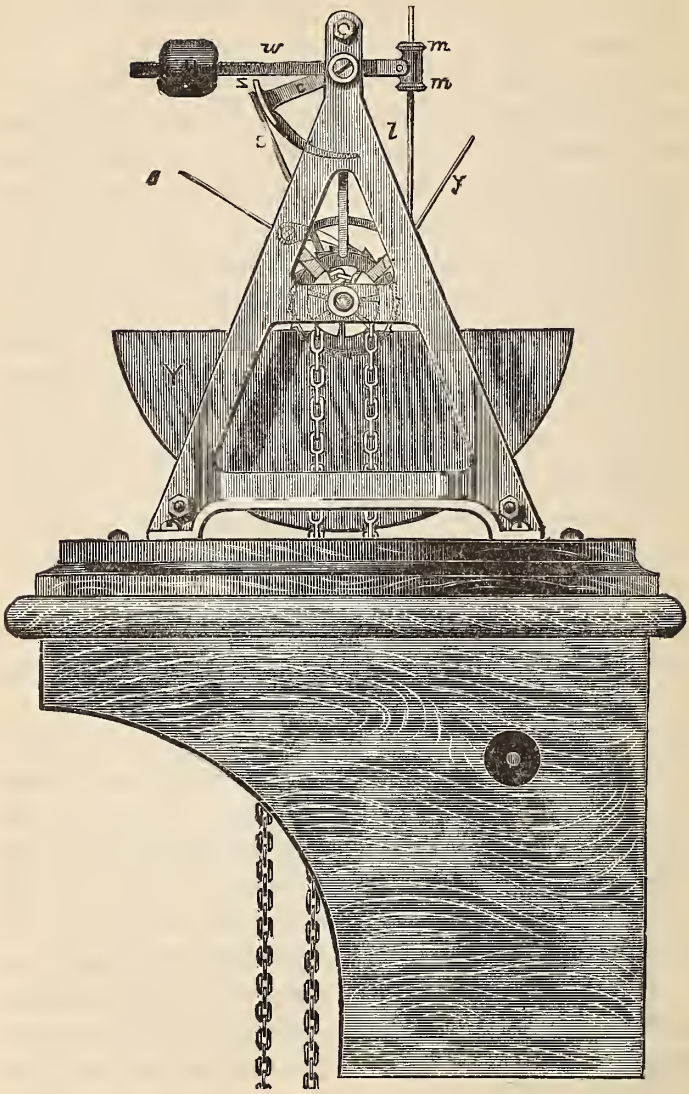


FIG. 8.

which is a pasteboad made from tarred junk, and it is thoroughly varnished with shellac to repel moisture.

SMITH'S INCUBATOR.

This machine is heated by radiation from tanks of hot water, but has some peculiarities not found in other egg-hatching apparatus. Mr. F. M. Smith, of Syracuse, is the inventor, but does not enter actively into competition with other manufacturers of incubators, at present being engaged in superintending the work of erecting buildings and all necessary fixtures of a large poultry establishment for other parties. He is a mining engineer by profession, and went about the task of making an incubator with certain intelligence, which is a good equipment for making experiments in anything that requires scientific knowledge. At first he constructed several *hot air* machines, and found that while he could easily get the proper temperature, and control it without difficulty, there was the question of *moisture* remaining to be solved. He ascertained by actual experiment — weighing the eggs that had been placed under hens once in three days through the time of sitting — that there was a loss in weight of one-sixth, the loss being uniform through the period of incubation. Under a dry, hot air process the loss would be greater, causing death to the embryo, or weakness in the fully formed chick, rendering it impossible to break through the tough lining of the shell. So he resorted to water-tanks, placing one above the egg-chamber and one below; the former to radiate "top heat" for the eggs and the latter to supply moisture for the atmosphere as it passed into the space occupied by the eggs. These tanks were made large, holding fifteen

gallons or more, and were each heated by an independent lamp, and the upper tank encased in non-conducting material. Mr. Smith says: —

"The peculiar and distinguishing feature of my incubator — so far as I am aware — is the construction of the heating tank, by means of which the incoming air currents, after first passing over the surface of the water in the moisture tank, becoming properly modified in temperature and humidity, and thence passing through the egg-tray, cooling and ventilating the eggs, finally pass into the upper or heating tank and over the surface of the hot water contained in it, and thence out through the ventilator. This arrangement furnishes an instant and powerful means of regulating and checking any excess of temperature through the large evaporation thus effected in the upper tank, as may be readily understood by any one familiar with the dynamics of heat and evaporation. It renders the incubator comparatively independent of the heat of summer days, or the chilly air of other seasons, although, for many reasons, it is always desirable to operate an incubator in an air of mild and uniform temperature — 60° to 80°, say."

The temperature is regulated by means of a galvanic battery in connection with the thermostatic bar. Above the upper tank is an appartment which receives the waste heat of the incubator. It answers the purpose of a brooder; a place where the chicks may be deposited as fast as hatched, and remain till they eat (a day or more), when they may be removed to larger quarters. Sufficient ventilation is provided, and this temporary

brooder is altogether a comfortable place for the first period of chicken life.

THE NATIONAL INCUBATOR.

This machine has been before the public, since first brought into notice, about ten years, and during that time has been seen in operation by a greater number of people than any other incubator, having been exhibited in all the principle cities in the Union where Poultry Shows have been held. The proprietors adopted the practice of selling the chicks hatched at these shows, giving ocular demonstration of what the machine would do, and affording visitors opportunity to take home with them real products of "Axford's" Incubator. The body of the machine is made of wood, in a circular form, supported on frame work, and surrounded with some material suitable to prevent heat from radiating. No water tanks are used. The heat is introduced to the space over the eggs by a pipe connecting with an oil stove outside; said stove being formed of two cylinders, one within the other, the space between them being packed. The egg trays are made to fit the form of the machine, and revolve, so that each one may be moved in turn against the door for turning eggs, etc. The eggs are turned by hand, the inventor claiming that a nimble hand will turn seven hundred in twenty minutes, and the devices for turning eggs by a lever or crank are useless (?) because by this process some of the eggs are left unturned and a portion of the embryonic chicks killed.

An electric battery is used, and by the regulating apparatus, when the temperature in the egg-chamber rises

to a certain point, an electric bell rings, and keeps sounding the alarm till the temperature is reduced by shutting off the current.

This is a hot air machine that has produced good results, and it is claimed for the heating arrangement that when the heat is high enough, or just right in the egg-chamber, it is retained in the heating apparatus for future use, and that in case the outside temperature lowers this retained heat will enter the egg-chamber, and thus the incubator may be successfully operated in a warm room, or in a cold location.

THE RELIANCE INCUBATOR.

It is our design to give descriptions of such machines as will illustrate all the methods of artificial incubation that have been found useful, and the principles involved. While the greater number of inventors have resorted to tanks of heated water from which to get radiation of heat, here is a Rhode Island manufacturer of incubators with a new kind of radiator—soapstone. Not exactly new, but a new application. Probably the inventor had felt the comfort afforded by hot soapstone placed in the cutter for the feet, making a warm atmosphere under the robes in the coldest day of winter. This substance retains heat well, imparting it gradually and gently. In the incubator the object is to supply heat to the stone just as fast as it is radiated in the egg-chamber, and through this medium get an even temperature among all the eggs. Of course the soapstone is placed in the upper part of the incubator over the eggs; and the heat is supplied to it by hot water pipes which are imbedded

in the stone. Only six quarts of water are used at one time for heating.

The body of the incubator is made of metal, double, with a space of one inch to be filled with non-conducting material around the whole machine. There are two separate egg-drawers with a ventilator over each. These ventilators are never closed; which is another peculiar feature. Evaporating pans supply moisture to the air as it passes into the egg-chamber.

An oil stove of special pattern is used for heating. No electricity is used; neither a pyrometer or thermostatic bar. The inventor, James Dennis, of Providence, does not approve these means for regulating heat, claiming that his incubator has the merit of simplicity, and that the regulating appliances used in many other machines are on a wrong principle. His argument in this line runs as follows:—

"First. All machines with this description of regulator depend entirely on the working of the regulator for ventilation; consequently, should the flame of the lamp, by accident, be set so as to produce just heat enough to keep the egg-drawer at the desired temperature for several hours, the pyrometer or thermostat remains at rest, and the ventilator remains closed, and the air becomes foul (especially when it is near the time for the chicks to leave the shell), which injures if it is not fatal to the incipient chick.

"Second. A continuous irregularity of the heat in the egg-drawer is the unavoidable result of these regulators, because in order to have the regulator open the ventilator, the air in the egg-drawer must get too hot, and as it is

of vital importance that the ventilator should open, it is necessary to purposely set the flame so as to produce too much heat, and after getting the egg-drawer too hot, the ventilator opens, and the machine gets too cool, when the ventilator is again shut, and immediately proceeds to get too hot again. And the three weeks' time is thus made up of fluctuating temperature, without a moment of even heat (unless by accident). And I claim that an even temperature with constant, perfect ventilation is of vital importance to practical success.

"Several of the most popular inventors and manufacturers of Incubators go so far as to state in their circulars that the ventilation of their respective machines is perfect, because the thermostat causes the ventilator to open every fifteen or twenty minutes, thus acknowledging that the temperature of the air in the egg-drawer is constantly and rapidly fluctuating."

There is a saying somewhere. "Know you are right, and then go ahead." By actual trials, and by constant, earnest discussion of such a subject as this, men come to right conclusions.

THE SELF-REGULATING INCUBATOR.

It would seem that nearly all the superlative terms to be found in the English language have been exhausted in giving names to incubators. When an inventor calls his machine merely a "self-regulating" incubator, we may well think that he is modest, and his invention may be worth examination. This is a hatching apparatus made in Oakland, Cal., by J. M. Halsted, and lately patented. It is operated by hot air directly, without

tanks. The description we have is not very clear, bu. we insert it for the benefit of our friends on the Pacific coast. There are two questions to be asked about every machine: — How is it made? and What percentage of eggs will it hatch, on an average?

"It is made of five of the best non-conducting substances and constructed so thoroughly that years of constant service will not impair its efficiency. The front is furnished with double glass doors through which the eggs and thermometer are visible without opening the machine. By the scientific manner in which the heating apparatus is constructed, every particle of heat is utilized and a great saving of oil is effected. The air thus warmed is automatically moistened by an ingenious device, before entering the egg-chamber, through which it passes in a constant current over the eggs and then through the ventilators, which are always open, yet placed in such a position that no cold air can enter. The moisture can be increased or decreased as desired, which being done automatically, avoids the necessity of sprinkling the eggs daily by hand.

"The lamp gives sufficient heat to use the machine successfully in the coldest climate, and yet is so constructed that it works equally well in the warmest.

"The formation of the heating apparatus is such that neither smoke nor gas can enter the egg-chamber, in which the air is constantly changing, therefore it must always be pure and wholesome. Underneath the eggs a current of cool — not cold — air is kept circulating, which as it becomes impregnated by carbonic acid gas from the eggs, passes out through the bottom ventilators.

"The new Patent Regulator is the Perfection of Simplicity, is strong, reliable and will last a lifetime; it is connected directly with the lamp and turns the flame up or down with the least variation of temperature.

"Above the egg-chamber is an artificial brooder, in which the young chicks can be placed as soon as dry."

INCUBATOR-CHICKENS.

It has been the experience of many, at the beginning of their work in hatching and rearing chickens artificially, that the mere hatching was not so difficult as the rearing. Reports have come to us frequently of enthusiastic experimenters using incubators of their own construction, ("hum-made") of very good success, a large per cent. of eggs hatching, "just as well as in a patent machine." Yet afterwards comes a moan of regret because of the failure to rear the little fledgelings. They would drop off, one after another till every one bit the dust. Mr. F. M. Smith, in alluding to this subject, writes: —

"It is mere amusement to hatch chickens in an incubator, but is serious work to rear them into strong, hardy and perfect birds.

Incubator chickens in general have a bad name, in consequence of the ignorance, neglect or niggardliness of those who are responsible for bringing them into life and who ought to provide for them well."

Chickens hatched in an incubator may be as vigorous and promising as those hatched in the natural way; yet a few days of neglect or bad management will kill them or so lower their vitality that they will be of no value. We may suppose that the eggs have been subjected to

the proper temperature twenty-one days, with all the other requisite conditions, the chicks come out and get dry in an appartment of gentle warmth—what do they lack but a *mother*? They must nestle somewhere, and get their downy backs under something very like the wings of a hen.

And this subject must receive attention beforehand. Look out for the "little things." There is no time for procrastination. A warm place is necessary, where the birds can nestle; for when chickens desire to nestle they *must* do it or suffer.

This fact being patent nearly all manufacturers of incubators have made "Brooders" or "Artificial Mothers" to go with their machines.

A small incubator may be used, or a limited number of chickens reared by taking precaution to have sitting hens in readiness to take the birds under their care as soon as hatched. A large hen, having the motherly instinct strong, will brood thirty or more chicks successfully if placed in a good coop, care being taken to keep every thing clean. This plan will answer for business on a small scale. There will be an occassional vicious or ill-behaved hen, and we are told, especially by those persons who make brooders to sell, that it is *safest* to put little chickens under an artificial mother, whether they may have been hatched naturally or artificially; because, forsooth, under the hens wings they get vermin; the hen gobbles up the food designed especially for the chicks, such as chopped boiled eggs, etc.; she tramples on them so that they die; she throws them backward, right and left, as she scratches for a worm, then eats the worm

herself; she leads them into the wet grass and they get bedraggled and chilled so much that no after-warming will prevent cramps; and she stands when she ought to sit down and gather her chickens together under her wings, instead of letting them shiver in the cold wind. Well, in some cases, this is a true indictment. Such is an unnatural mother.

The time is past for making an argument for or against artificial brooders. There is no better brooder than a good old hen, and the good old hen will continue to act in her proper sphere. But something else must follow the incubator, as a rule. The desire to rear large numbers of chickens at a time has stimulated thought and invention. Many experiments have been tried, sometimes with utter failure; but generally with success. The failures are not often reported. These are suppressed, and success is heralded. One man tells the whole story. *Prof. Corbett*, years ago, hatched great numbers of chickens by the heat of fermenting horse manure, and he gives his experience in rearing them without hens, thus: —

"Those persons who have never seen hundreds of young chickens of one and two days old, can form no idea of the busy and noisy household. Luckily, we had an artificial mother, warmed by one lamp, and I placed the young chickens in it; whether it was the smell of the kerosene that was injurious to them, or whether the heat produced by the hot water did not accomplish the wished-for object, I lost the greater number of them, and I had the misfortune to prove that it was especially from crowding themselves in the corners that they died. This was a bitter disappointment. I, first of all, began my im-

provements on the artificial mother, in suppressing the corners, as much as possible, and at last had one built without corners, measuring twelve feet in length and ten feet in width, and warmed by two kerosene stoves. I thought myself very happy in having such a large artificial mother, in which I could place 1,800 chickens of different ages. Every thing was complete in it — park, perches and ventilation. Unfortunately, one night in April one of the lamps exploded and set on fire the building which it was in, and which measured 200 feet in length and cost $6,000. The dog gave the alarm, and soon every one on the farm was awakened, and commenced to extinguish the fire by means of the India-rubber hose kept on the premises for such a calamity, and with a plentiful supply of water the building was saved by a miracle, but I was not so fortunate with my young brood; nearly all of them were smothered or suffocated. Again was I forced to resign myself to fate and give up the raising of my pullets artificially by means of lamps. The insurance company paid the damage to the building, but the poultry was not insured."

Brooders, as commonly made, are quite simple. A box is used of rectangular shape — better round — covered with a tank for holding warm water. This tank is connected with a small boiler which is heated by a kerosene lamp. This, indeed, seems the most feasible method of obtaining a steady, gentle heat. Under the tank is a space for the chickens, not all of the same height, but graduated to suit chicks of different ages, and over this space is soft flannel hung in folds, or sheep skin with the wool on, fixed in such manner that chickens of dif-

ferent sizes may crowd their backs against the warm surface.

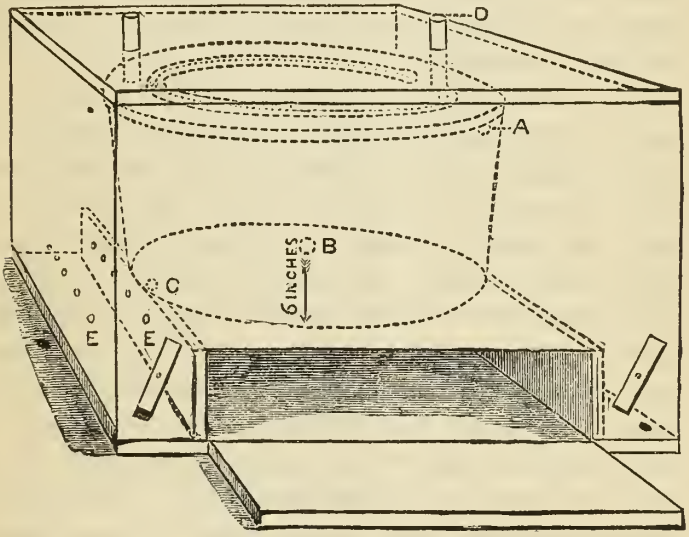
In such a place if those of about the same age are kept together, the little ones will brood contented and happy. Effective brooders have been made in a circular form like a cheese box, having a tank above filled with hot water, renewing the water twice a day by drawing off a portion and supplying its place by boiling water. In this plan the tank must be large and well covered with felt or some non-conductor of heat.

Whatever the form or plan of a brooder, provision must be made for ample ventilation. Not only must the chicks have a dry place to huddle together safely but a place where they may come out and enjoy the sunlight, a yard or run. This should be covered with glass for early chickens, but later in the season no glass is necessary. There comes the testimony of many persons who have reared chickens in this manner, that the birds grow faster, have no lice, get larger during the season, with finer and more glossy plumage than those brought up in the natural way. But there must be considerable allowance or discount from what people say if those people are not entirely disinterested. When we meet a man who rears many hundred in a season, and he declares that he rears them in "Brooders" with less loss and less work than with hens, that is good testimony, and no mere theory.

HOME-MADE INCUBATOR.

The cost of a first-class incubator deters some persons of small means from purchasing. They reason that they must not only bear the first outlay, but the risk of

failure. Not stinginess alone, but cautiousness prevents them from purchasing. Among this class are a few who will attempt the construction of home-made incubators; and they must, as a necessity, all resort to about the same plan — something resembling Christy's Hydro Incubator. They want a *cheap* apparatus, and an incubator on this principle is the cheapest in construction. While



we would not advise the making of a cheap affair, to be put together by unskilled hands, yet it is a fact that some men have got chickens out of such an incubator, and also a great deal of pleasure, if we may judge by the way they tell the story. In order to help those who are anxious to help themselves in this direction, we quote from a writer in the "*Poultry, Cage Birds, Etc.*," an English publication: —

"I have noticed a good many inquiries for suggestions about home-made incubators. As I have not noticed any practical answers, I send the particulars of one I made a few years ago, which worked all right, with the advantage that, when it was done with, the materials were worth nearly what they cost.

"The size need not be kept to, exactly, though it is larger than the trade-made ones. I don't think smaller would give enough bulk of water to retain the heat in this shape of tank.

"To commence with I bought a sound second-hand packing-case, 39 inches long, 29 wide, 25 deep, made of inch deal; cost two shillings. For the hot water tank a galvanized iron bath, 27 inches long, 18 wide, 13 deep, the sides as upright as I could obtain; greater depth would be better; cost four shillings. Measure how many gallons it will hold, make a cover to it of inch board battened on the top side with a hole near each end; through one put a length of three-quarters or larger compo pipe closed at the end, pierce holes in it about an inch apart with a small bradawl, bend it to about the shape of the tank, and secure it on the under side of the cover with a few staples or nails driven across. I did this so as not to disturb the bottom layer of water when pouring fresh in. Put a piece of pipe about 10 inches or so just through the other hole to let off the steam.

"Make three holes in the bath and solder in pieces of pipe, about nine inches long, one at A for overflow pipe, one at B for running out the water to change, and one at C to empty entirely. This part of the work, unless

he is used to it, an amateur had better get done by a tinman, as thin galvanized iron and compo pipe is rather difficult stuff to make water-tight joints in. Of course the joints must be perfect, as ever so slight a leakage would upset the whole affair.

"For this to rest on, put two pieces of inch deal about seven inches wide edgeways up, the width of the packing-case, with a few clean-bored holes at E, and the same on the outside. Place another piece between them about three inches from the back.

"These measurements would be regulated by the size of the bottom of the tank. Make the pieces of wood so as to just support firmly the back and two ends. Make all this firm and square. Next cut the piece out of the case in front, and hinge at bottom to fall down outwards; this makes a support for the egg-drawer when pulled out. Put two strong wooden buttons to fasten it up. Make an easy running drawer to fit the space under the tank; it requires to be made strong.

"For the packing to retain the heat; having by me a quantity of woolen rags, bits of damask, soft drugget and cloth, I used them for it.

"Tack a thickish piece across for the bottom of the tank to rest on, measure and make holes in the case for the three pipes to come through.

"In placing the tank in position be very careful with the pipes so as not to break the joints. Put a piece of board to prevent the packing falling in front of the tank.

"Pack tightly up to the level of the bottom with clean straw, then pack in the rags — put all the softest

and best next the tank. Pack it carefully, the closer and firmer it is done the better it will hold the heat. Bore holes in the top of the case for the two pipes, pack up well and screw down tight. I put taps to the three pipes, A, B, C; they are much the handiest, but good corks would do if well secured.

"It is now ready to commence operations. Bore a few holes in bottom of egg-drawer, fill with dampish mould, with chaff or cut straw on it, to within two inches of the top; lay the thermometer in face upwards, pack with soft rags tight in front of drawer, button up opening.

"Place a funnel in pipe D and pour in boiling water — not so much by nearly a gallon as the tank held of cold water — bind up all portions of pipes that come outside to prevent them radiating the heat; leave it for twenty-four hours, then see what the thermometer says, book all details for future reference. Run out the water down to B, notice its temperature, measure the quantity and put in the same of boiling water, fasten all up. The temperature of the drawer may be tried two or three times in the course of twelve hours, it ought then to register somewhere from 98° to 104°. Run off and refill again, leave for twelve hours, and if the heat is then about 101° it will be pretty safe to put the eggs in. It would be safer to try it another twelve hours, and the experience is worth the trouble. The heat is regulated by the quantity, more or less, of fresh boiling water; mine generally took from three to five gallons.

"Never let the heat go over 104° or under 98°. I found 100° to 102° worked very well. The ventilation

can be regulated, also the heat, by the packing in front of drawer and opening or plugging the holes at E. If the front of the drawer is made about three-quarter inch lower than the sides, the thermometer can be slipped in and out without moving the drawer. I used Christy's low-scale thermometer. The incubator as described kept the heat very level; it has been left unattended for eighteen hours.

"A 'rearing mother' can be made on the same principle, but much simpler, by putting siphons for running out the water, or the incubator can be used by having another drawer instead of the egg-drawer, with some soft thick material cut in fringes and tacked across under the tank and a small wire run to hook on front opening.

"In conclusion allow me to remark that hydro-incubation is not quite all plain sailing; there is a certain amount of judgment required which can not well be explained, and which comes best by practice. The temperature of the outer air, the dampness in the drawer, the not losing much heat when turning the eggs, the amount of the ventilation, the feel of the eggs, must all be thought of and allowed for; and when you have once commenced it is a great tie to have to be ready every twelve hours with four or five gallons of boiling water, Sunday and week-day, for three weeks. Anyhow the hens appear to enjoy hatching more than I do, and I know in fair weather they can feed the chicks and brood them better than I can."

In the experiments conducted by amateurs in this country, sawdust has been sometimes used as packing in

home-made incubators. Mr. P. H. Jacobs, writing in the *Agriculturist* on this subject, says: —

"Nearly all the makers of incubators have testimonials in proof of their efficiency, and some of them are excellent. The inquiries now are about those 'home-made.' Two methods of construction were adopted for the trials; several made by the operators and heated by lamps, hatched well. The average percentage of chickens may be safely stated at sixty per-cent. One gentleman secured over eighty per-cent from three trials, with about one thousand two hundred eggs, one thousand chicks being hatched. One incubator, which was operated by drawing off cold water from a tank daily, and replacing it with heated water, gave fifty per-cent. In every case the operators were novices. The secret of success is in the storage of heat by the sawdust packing which, when fully warmed, gives off the heat very slowly, thus preventing sudden changes of temperature. The thicker the packing of sawdust, the longer the retention of heat, but of course this increases the dimensions of the incubator without corresponding increase of capacity. The hot-water incubator is the safest, as no lamps are used. To hold one hundred eggs, the tank should be eighteen inches wide and thirty inches long, and the depth not less than twelve inches, as the deeper it is the greater the volume of water, and the longer will the heat be retained. The tank is larger than the drawer, as the former rests on supports, while the drawer slides in and out under it. The ventilator and drawer are of the same dimensions (making allowance for the packing), and would therefore be an inch all around

less than the tank, or sixteen by twenty-eight. Every two inches added to the length of the tank gives room for another row of eggs. The largest incubators used in Hammonton are three feet wide and four feet long, the capacity being a little over three hundred eggs. To hold seven hundred eggs, the drawer should be about four feet wide and six feet long. The incubators are ventilated by pure air passing under the bottom, then through tin tubes just under the egg-drawer, while the heat is radiated upon the eggs from the tank above. Many suppose that incubators require but little care, and numerous mistakes are the result. To hatch successfully, any operator should be willing to devote as much time and labor to the management of incubators as he would to other important painstaking enterprises that are expected to be profitable."

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